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DEVELOPMENT OF YOUNG KING RAIL. A. (*Above*) 4 days of age: downy young showing pied bill and egg tooth. B. (*Below*) 31 days: downy young with juvenal plumage beginning to develop. White auriculars and white feathers on crural tract visible; tip of bill and nares white. Photos by B. and A. G. Meanley.

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GROWTH AND DEVELOPMENT OF THE KING RAIL

BY BROOKE MEANLEY AND ANNA GILKESON MEANLEY

GROWTH and development of the King Rail (*Rallus elegans*) from hatching to first flight were studied by observations and measurements of captive birds and by observations of natural nests in the field. This is the fourth in a series of reports on the life history of the King Rail (Meanley 1953, 1956, and 1957). Information in this paper is intended to supplement the data of Bent (1925) on growth and development and the description of juvenal plumage given by Friedmann (1941).

METHODS

In July of 1956, we removed three newly-hatched rail chicks from their natural nest in a Louisiana rice field, planning to rear them in captivity. We were surprised to find that it was not at all difficult to care for the chicks. They fed readily on a variety of foods including chick starter and chick grower mash, rice seed, canned sardines, angle worms, and grasshoppers. In May of 1957, we obtained two more chicks and cared for them as for the first. Three of the chicks lived to flying age and were released in the wild when they were twelve months old. We believe that obtaining the chicks when they were very young and keeping several chicks together were both important factors in our success in rearing them.

As the chicks developed, we weighed and measured them at intervals, as shown in Table 1, and made notes on their behavior and calls. We also studied the behavior of newly hatched chicks in five natural nests we found in the rice fields.

APPEARANCE AND BEHAVIOR OF FIRST-DAY CHICK

The newly hatched King Rail is very weak and wet. Contrary to the statements of Audubon (1835) and Howell (1932), it is unable to run about and follow its parents as soon as it is hatched. Sometimes it

emerges from the shell on its back, and lies kicking and struggling for some minutes before righting itself. A nest mate may grab its toes or beak and so stimulate further activity. Most of the chicks we observed were more than an hour old before they were able to go over the side of the nest and return. Chicks 15–20 minutes old had considerable difficulty when we placed them in weeds and water outside of their nest and they could not get back into the nest under their own power.

As the down dries out the young bird moves more actively about the nest, the undeveloped wings assisting in this effort. As the rail chick begins to gain strength, it sits on its tarsi and assumes a begging display, with wings extended for balance.

The period of fluffing-out often takes one-half hour or longer. It took four and one-half hours for one of the chicks we observed. The fluffing-out process may be necessary to produce buoyancy needed to enter the water safely, as Gullion (1954) suggested for the Coot (*Fulica americana*).

Chicks took food from their parents' beaks the first day but we did not see them picking up food from the ground until the second day.

The day-old chick has at least two calls: a loud begging call, *chee-up;* and a soft lower pitched call of contentment, *wee* and *wee-up*.

The young bird loses weight throughout the first day of life. One female chick weighed 16.3 grams at hatching, 16.0 grams at one hour, 15.7 grams at two hours, and 13.2 grams at 24 hours. The day-old rail is covered with black down that has a faint greenish sheen or cast except in areas where it is thickest. The down is very dense on the abdomen and sparse on the crown. The bill has a pied pattern: the basal half is grayish black, the narial region is white, the distal portion is flesh-colored, and the egg tooth at the tip is white. The egg tooth is lost between the fourth and sixth day. Legs and feet are brownish-gray in color, although at a quick glance they appear black. A vestigal claw is present.

One to Thirty Days

During the first month of life the major change in the appearance of the King Rail chick is one of size and conformation (Plate 18 A and B). A young captive male weighed 16.7 grams when he was one and a half days old and 96.3 grams when he was a month old. His measurements, at one and a half and 30 days respectively were: Exposed culmen, 11.0 and 28.0 mm.; tarsus, 20.0 and 42.0 mm.; middle toe with claw, 22.0 and 50.0 mm.

The thick natal down remains throughout the period; but during

TABLE 1

GROWTH OF YOUNG KING RAILS

Age	*Bird*	*Weight (grams)*	*Exposed Culmen (mm.)*	*Middle Toe with Claw (mm.)*	*Tarsus (mm.)*
Hatching	A	16.3 (wet)			
1 hr.	A	16.0			
2 hr.	A	15.7			
1 day	A	13.2	11.0	20.0	20.0
1 day	B	15.6			
1½	C	16.7	11.0	22.0	20.0
1½	D	15.6			
7 da.	B	18.9			
7 da.	B	18.9			
7–8 da.	C	25.7			
7–8 da.	D	19.7			
8 da.	A	14.0	12.5	26.0	21.5
17	B	37.0	20.0		
17–18	C	46.5	21.0	36.0	32.0
17–18	D	32.0			
21 da.	A	40.0	19.5	36.0	29.0
21 da.	B	50.7			
21 da.	C	63.8			
21 da.	D	47.7			
1 month	B	75.4	25.0	42.5	38.5
1 month	C	96.3	28.0	50.0	42.0
1 month	D	70.8	25.0	43.0	36.5
1½ mo.	A				
1½ mo.	B	177.9	40.0	49.0	52.0
1½ mo.	C	219.8	40.0	61.0	56.0
1½ mo.	D	176.0			
2 mo.	A	202.0	40.0	57.0	53.0
2 mo.	B				
2 mo.	C	327.0	48.0	61.0	58.0
2 mo.	D	258.6			
3 mo.	A	265.0	49.0	57.0	53.0

the fourth week there is evidence of development of the juvenal plumage.

Toward the end of the first month the young rail begins walking more deliberately and assumes the gait of the adult bird. When it is seeking food intently, it also tips its tail in typical adult fashion. Tail tipping was observed in one two-week-old individual.

Month-old King Rails have at least four calls: (1) *seep-seep-seep-* (repeated). This call indicates general satisfaction and, particularly,

acknowledges the presence of others and notifies them of its presence; (2) *tah-eee! tah-eee!* (repeated), very high pitched, and progressively lower in volume as sleep approaches. This call indicates relaxed comfort and sleepiness. (3) *soo, tsoo* (tsŏo) indicates lonely dissatisfaction. (4) *keelp-keelp-keelp-*, a series of five or six hoarse notes in rapid sequence, expresses protest.

THIRTY TO SIXTY DAYS

The second month is the period of most dynamic plumage development—the juvenile body plumage replaces the natal down (Plate 19, C and D). The first juvenal feathers may be obscured by down until the young rail is nearly a month old. By the *seventh* or *eighth week*, development of virtually all body feathers is complete. The plumage of four captive rail chicks developed at about the same rate through the first six weeks, but thereafter there was considerable variation.

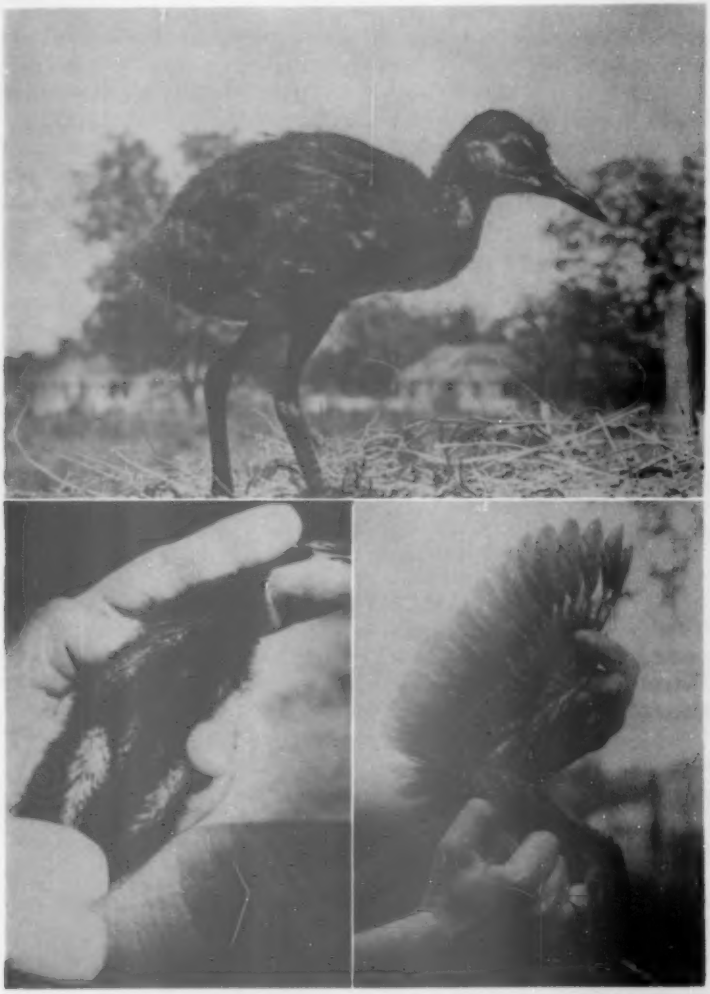
The first evidence of a change from the natal down plumage is the appearance of white auricular tufts and pale juvenal feathers on the underparts and flanks. Feather development in these areas during the *fourth week* is as follows:

(1) The sternal region of the ventral tract: The pinfeathers in this area are pale buffy brown, and are tipped with natal down that is being pushed out.
(2) The crural tract: Pinfeathers are whitish with black down at tips.
(3) Femoral tract: Feathers are approximately the same color as those of ventral tract.

By the latter part of the *fifth week* the juvenal plumage is developing in all body areas of most young rails. Feathering of the crown and back of the neck may begin slightly later in some individuals. The abdominal and axillary regions, the chin and upper throat are whitish and contrast rather sharply with the dusky upper parts, particularly the lower back and rump. The dark brown feathers of the upper back and humeral tract are well advanced. The feathers of the cervical region (lower throat) are approaching cinnamon in color. Feathers of the sternal region and femoral tract are faintly barred. The upper and undertail coverts are making their appearance and the anal circlet is surrounded by short white feathers.

Quills began to appear the *latter part of the fifth week* on the wings and tail of two of four captive birds. The primary and secondary coverts develop faster than the primaries and secondaries. The lining of the wing develops last.

By the *sixth week* the side of the head is whitish, faintly washed with



DEVELOPMENT OF YOUNG KING RAIL. (*Above*) C. 50 days: young with juvenal plumage nearly complete. Tail and wings are undeveloped. This individual is slightly behind the average for this age. (*Below, left*) D. 51 days: ventral view showing development of white juvenal plumage on ventral feather tract. (*Below, right*) E. 62 days: development of remiges nearly complete. Can make short flights. Photos by B. and A. G. Meanley.

gray, and a white superciliary stripe is beginning to appear. The legs and bill now approach a flesh color, and the distal half of the bill is darker than the proximal part.

By the *seventh* or *eighth week*, the juvenal body plumage is almost complete and the young King Rail has a more brownish and less dusky appearance. The cinnamon coloring of the lower throat and breast approach that of the adult. The juvenal feathering of the crown and nape is complete in most young birds of this age. The flight feathers and tail are well advanced on most birds.

There may be considerable variation in the weight and size of young rails during the second month of development. At two months of age, a captive male and two captive females weighed 327.0, 258.6, and 202.0 grams respectively. For comparison the weight of a live wild adult male was 339.9 grams; and the weights of three freshly killed wild adult females were 364.5, 325.0 and 305.0 grams.

Call notes of young rails remain essentially the same during the second month of life as they were during the first month, but the voice becomes a little hoarser and deeper. During the second month the young rail frequently exercises by jumping up and down, flapping its wings at the same time.

DEVELOPMENT AFTER 60 DAYS

The development of the juvenal plumage is nearly complete by the age of *60 days*. Molt of the juvenal plumage occurred in the fall, when most of the birds were *four to six months* old. Captive rails hatched in early May and those hatched in early July all began the post-juvenal body molt in late October and early November.

The beginning of flight seems to coincide with the completion of juvenal plumage development (Plate 19, E). Two of the three captive rails began to fly at *nine weeks*, the third at *eleven weeks*.

The begging display still may be observed occasionally during the *ninth* and *tenth weeks* but it soon disappears.

A considerable change in calls occurs during the *ninth* and *tenth weeks*. Some of them now approximate the calls of the adults. The call most like that of an adult bird is a raucous crying squawk or catlike "meow." This call is made when the bird is separated from the family group or is excited. The typical *jupe-jupe-jupe* call of the adult was not heard until about the *fifth month*.

SUMMARY

Information about the growth and development of the King Rail from hatching until first flight was obtained from five birds reared in captivity. The newly hatched rail chick is weak and wet, and is at

least one-half hour old and dried out before it is able to go over the side of its nest. It loses weight during the first day. Two different calls were given by the day-old chick.

During the first month of life the major change in the appearance of the King Rail is one of size and conformation. Four different calls were recorded for month-old King Rails.

The period from thirty to sixty days is the one of most dynamic plumage development—the juvenal body plumage replaces the natal down. Juvenal plumage first appears with the white auricular tufts and on the underparts and flanks. The crown and nape are the last areas to attain juvenal plumage.

The beginning of flight seems to coincide with the completion of juvenal plumage development. Three of four captive rails began to fly at nine weeks, the fourth at eleven weeks.

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Patuxent Research Refuge, Laurel, Maryland and Linthicum Heights, Maryland.

WILLIAM ROWAN 1891-1957

IN MEMORIAM: WILLIAM ROWAN

BY W. RAY SALT

PROFESSOR William Rowan, who became an Associate of the American Ornithologists' Union in 1920, a Member in 1927, and a Fellow in 1950, died at Edmonton, Alberta, on June 30, 1957. He was born in Basle, Switzerland, on July 29, 1891. Much of his early life was spent in England but in 1908 he came to Canada and worked for a time as a ranch hand in Alberta. He soon returned to England, however, to continue his formal education. This was interrupted by a period of army service during the First World War but after his discharge as a casualty he graduated in University College, London, with the B.Sc. degree in 1917. He had early shown an interest in nature and his undergraduate work had been largely in the field of biology. In 1919 he went to the University of Manitoba to lecture in zoology and, the following year, came to the University of Alberta at Edmonton as a member of the department of biology. In 1921 he became the sole member of the newly-organized department of zoology, a department which he developed and headed until his retirement in 1956.

When he arrived in Alberta, Rowan already had a good knowledge of British birds and great enthusiasm for ornithological studies. With C. G. Harrold of Winnipeg he spent several years observing the migrating waders which stopped in great variety and incredible numbers at Beaverhills Lake east of Edmonton. He accumulated a fine collection of skins and considerable new information, much of which he published in "British Birds" between 1926 and 1929. This series of articles, "Notes on Alberta Waders included on the British List," carries illustrations by the author which are excellent examples of his skill with a pencil. During the same period he was also carrying on in his own back-yard the initial experiments which ultimately brought him fame as an experimental ornithologist. By subjecting birds to increasing or decreasing amounts of artificial light he showed that the cyclical development of their gonads is dependent upon seasonal fluctuations in day-length and, searching for the secret of migration, he reasoned that a gonadal hormone might be the trigger which sets off an inherent migratory impulse. With this in mind he set up further experiments using first juncos and later crows in an attempt to upset their normal migratory habits. The experiment with crows received wide publicity and made Rowan perhaps Canada's most widely known ornithological figure. In 1928 he returned to London for a year and presented the results of these experiments in a thesis for the D.Sc. degree in University College. "The Riddle of Migration," published in 1931, was an

exposition of his work in a form intelligible to the layman. Recognizing that his results had not been conclusive, he made a few attempts in later years to repeat the experiments with crows, but these were plagued with misfortune and he was never able to complete the work on the scale he had envisioned.

By this time Professor Rowan had lived in Alberta long enough to have witnessed at first hand the remarkable disappearance and recovery of the local populations of rabbits and grouse, and henceforth much of his energy was directed toward studies of these cyclical fluctuations in numbers. An ardent hunter, he felt that a knowledge of "the cycle" was essential to intelligent control of America's game resources if certain species were to be available to the sportsmen of the future. He kept records of numbers, age, sex, and weight of the game birds he shot and encouraged his friends to do the same. He had students working on various aspects of the problem. Such titles as "Canada's Premier Problem of Animal Conservation," New Biology Series, Penguin Book #9, 1950, and "Reflections on the Biology of Animal Cycles," Journal of Wildlife Management, 18 (1), 1954, indicate the new trend of his interest. At the time of his death he was investigating historical records of fluctuating populations. During summer vacations he spent some time in the field, favoring the wilderness areas north of Edmonton. He investigated at first hand numerous reports of Whooping Cranes nesting in these regions and concluded that some might be reliable.

Over the years Dr. Rowan became a Member of the British Ornithological Union, a Fellow of the Zoological Society of London, and a Fellow of the Royal Society of Canada. In 1946 in recognition of the merits of his research the Royal Society of Canada awarded him the Flavelle Medal. His talents were many. Drawing, sculpture, and music were their particular outlets; in each field he had had a little training and his works were of high quality. His drawing of Whooping Cranes was selected by the postal service for use in their wildlife series of postage stamps. As a naturalist he deplored the modern trend toward abstraction in art. Dr. Rowan's nature talks over the C.B.C. network allowed him opportunity to mix some of his own philosophy with his biological knowledge. During recent years his concern for the future of man, the most intelligent form of life, was reflected in all his talks and writings. Mankind, he felt, was headed towards self-destruction. We may but hope that the art of prophecy was not one of his many gifts.

A wide circle of acquaintances and correspondents grieve the passing of an able ornithologist, but those who had the privilege of observing the many facets of William Rowan's personality in the field, in the

laboratory, or over coffee in his "top-room" at the University, mourn a man whose influence has been felt far beyond ornithological circles.

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THE "HATCHING MUSCLE" IN THE CHICK

BY HARVEY I. FISHER

THE mechanism of hatching is little understood, and few investigators have concerned themselves with it. It has generally been accepted that the egg-tooth on the dorsal tip of the bill is a part of the apparatus that ruptures the shell. About 130 years ago Yarell (Rosenstadt, 1912) described the tooth and suggested its function. The tooth is usually pressed against the inner surface of the first "pip" or opening in the shell, but what causes the strong thrust that breaks the shell?

Since the chick's head and neck are flexed inside the shell, it is logical to presume that extension of the head or any of the cervical vertebrae could force the tooth against the shell. Keibel (1912) believed that M. complexus (Fig. 1) extended the head and thus provided the force. The development of the egg-tooth and M. complexus seem to parallel each other. The tooth first appears at 7 or 8 days of incubation, is not outstanding at 10 days, but thereafter develops rapidly to reach its greatest size at 20 days. M. complexus is present and somewhat enlarged as early as 7 or 8 days, judging from the enlargement observable in chicks (Lillie, 1919: figs. on pp. 212 and 213) and in the House Sparrow (*Passer domesticus*) and Red-winged Blackbird (*Agelaius phoeniceus*) (Witschii, 1956: figs. on pp. 326 and 316–317, respectively). Neither of these authors mentioned the muscle; unless one takes particular note of it, the enlargement seems to be a part of the usual cervical flexure. Pohlman (1919:98) noted that M. complexus reached its maximum development at about the 20th day of incubation and rapidly became smaller after hatching.

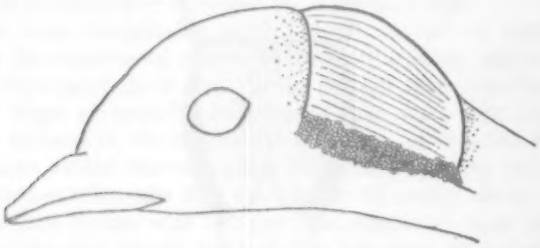


FIGURE 1. Diagrammatic lateral view of M. complexus of chick at hatching.

Despite the manner in which these two develop together and the apparent function of the mechanism, doubt has been cast on the ability of this muscle to contract vigorously. At least part of the

increased size is accumulated lymph. Pohlman (1919:101), who studied this muscle in some detail, stated that the lymph hinders muscular action and that this muscle ". . . is relaxed at the time of picking through the shell."

This paired muscle overlying M. spinalis and M. biventer cervicis originates from the neural spines of cervical vertebrae 3, 4, 5 and from fascia overlying the deeper muscles. It inserts fleshily and widely on the posterior edge of the parietal bones (Figs. 1 and 2). The muscle is composed of three segments separated by tendinous intersections; the segments are not usually visible from the 19th day of incubation to the 2nd day of age. A large lymph gland lies along either lateral surface of the muscles.

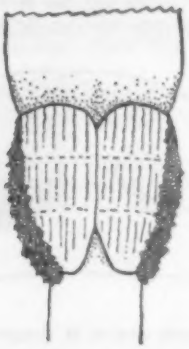


FIGURE 2. Diagrammatic dorsal view of M. complexus of chick at two days of age.

The homology of this transitory muscle is uncertain, but it is evident that the muscle is in an excellent structural position to provide a strong upward thrust of the egg-tooth.

Pohlman (1919:102) discounted the role of M. complexus in hatching. He believed that the extension was largely in the cervical region and that the force involved was touched off by a respiratory reflex—the drinking-choking reflex which is characterized by extension of the neck *and head* (Pohlman did not mention head-extension, although it is quite evident in this reflex in adults.) This reflex is reported to result from distention of the abdomen when the yolk sac is absorbed, or perhaps injected, into the digestive tract by M. levator ani, according to Pohlman.

In view of the conflicting opinions of Keibel and Pohlman, it was felt that further study of the development of this muscle and its function would be valuable.

MATERIALS AND METHODS

Eggs of Rhode Island Red chickens were incubated and samples taken daily, starting at 15 days of incubation; prior to this stage the muscle is so small that biometric study would involve large errors. Numbers of young so sacrificed are indicated in the tables. Forty-three pipped, but unhatched eggs were obtained on the 20th and 21st days of incubation; in most instances the embryos were already dead.

When the embryos were removed from the egg, the yolk sac was clipped off near the body. Surface moisture on the feathers was removed by gentle blotting, and the embryo was weighed to the nearest tenth of a gram. The muscle was dissected out, weighed in milligrams on a Roller-Smith torsion balance, and then immersed in Bouin's fixative.

Later, these muscles were sectioned (cross and longitudinal) and stained in haemotoxylin and eosin for histological study.

In the same recognizable part of each cross-section, counts were made of the numbers of contracted (densely stained) and of relaxed muscle fibers per unit of area. It was thought that these data might indicate stages of maturity and development and might also be an indirect measure of the infiltration of lymph, in that the fibers per unit of area should decrease as they are pushed apart by lymph. The same square-ruled ocular disk was used in all counts. It was difficult to make these counts with 100 per cent consistency from section to section of the same muscle, but variation was about 10 per cent.

Photographs were made of sections typical of the different age groups.

Later, two procedures were used to make it more difficult for chicks to pip the eggs and crack the shells to emerge. Two dozen eggs were hardboiled and the shells sawed transversely to form two cups, after removal of their contents including egg membranes. These paired cups of shells were placed over unhatched eggs at 15 days of incubation. A narrow band of cellophane tape held the cut edges together to form a second layer of shell over the unhatched chick. The second procedure was to wrap a three-fourths-inch wide strip of cellophane tape around the usual plane of pipping and cracking; this was also done at 15 days of incubation.

The reason for the use of these methods was that extra difficulty in hatching might cause excess strain and perhaps hemorrhage in the muscle, if the muscle functioned in hatching.

RESULTS

The segmented condition of the muscle is frequently obscured by the turgidity resulting from the infiltration of lymph. From the 19th day of incubation to the 2nd day of age, the segmentation can be observed only upon dissection. After the chick hatches, the muscle appears to widen anteriorly; the distance between the anterolateral corners of the two muscles increases. The insertion on the skull moves laterally on either side, and M. biventer cervicis and parts of the splenius complex become visible in dorsal view.

In Table 1 are data showing the gradual increase in weight of the muscle (in per cent of body weight) up to the 20th day of incubation.

TABLE 1

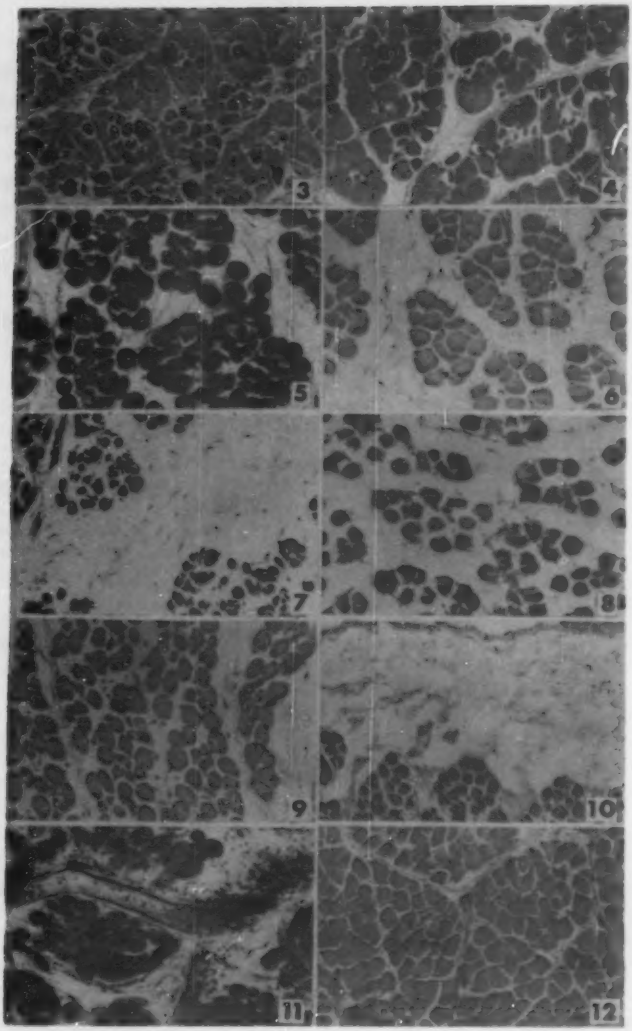
SIZE OF M. COMPLEXUS IN CHICKS OF DIFFERENT AGES, IN PER CENT BODY WEIGHT

Age	*No. spec.*	*Mean*	*Range*	*St. dev.*	*Coeff. var.*
15 days incubation	10	0.43±0.015	0.381–0.494	0.046	10.7
16 days incubation	10	0.56±0.038	0.376–0.742	0.113	20.2
17 days incubation	10	0.66±0.055	0.335–0.837	0.165	25.0
18 days incubation	10	0.95±0.074	0.627–1.379	0.221	23.3
19 days incubation	10	1.57±0.193	0.745–2.529	0.578	36.8
20 days incubation	10	1.93±0.280	0.689–3.406	0.841	43.6
At hatching	7	1.85±0.324	1.088–3.017	0.795	43.0
Pipped, but not hatched	43	1.34±0.065	0.68 –2.41	0.423	31.6
1 day after hatching	10	1.16±0.098	0.60 –1.63	0.295	25.4
2 days after hatching	10	1.04±0.084	0.69 –1.53	0.252	24.2
3 days after hatching	10	0.63±0.172	0.37 –1.93	0.516	81.9
4 days after hatching	10	0.50±0.069	0.31 –0.98	0.208	41.6
5 days after hatching	5	0.28±0.022	0.22 –0.33	0.044	15.7
6 days after hatching	5	0.49±0.053	0.35 –0.63	0.105	21.4
8 days after hatching	5	0.27±0.015	0.23 –0.30	0.029	10.7

Size on the 21st day is not significantly different. After hatching, there is a gradual decrease in weight, at least until the eighth day. Note that at 4 to 6 days of age the muscle has about the same gross size as at 15 days of incubation. Further, the maximum increase occurs between the 18th and 19th days of incubation, and the maximum decrease occurs within 24 hours after hatching.

In the 43 chicks which had pipped the egg but could not emerge, the muscle was only 1.34 per cent of body weight compared to 1.93 per cent in 10 embryos on the 20th day of incubation (Table 1). These values are significantly different at the 5 per cent level.

In Table 2 are representative counts of contracted and relaxed muscle fibers per unit of cross-sectional area. The number of contracted fibers decreases rapidly between the 15th and 19th days of



Cross-sections of M. complexus of the chick. 15 microns, haemotoxylin and eosin. Figures: 3) at 16 days of incubation; 4) at 17 days; 5) at 18 days; 6) at 19 days; 7) at 20 days; 8) at 21 days, hatching; 9-11) pipped but not hatched; 12) chick 5 days of age.

TABLE 2

NUMBER OF MUSCLE FIBERS PER UNIT CROSS-SECTIONAL AREA

Age	*Number specimens*	*Contracted*	*Relaxed*
15 days incubation	8	18 (8–40)	67 (40–86)
16 days incubation	5	11 (1–30)	49 (39–64)
17 days incubation	2	4 (3–13)	38 (32–46)
18 days incubation	4	3 (1–5)	40 (26–52)
19 days incubation	4	2.5 (1–5)	28 (18–36)
20 days incubation	9	1.1 (0–3)	24 (14–28)
At hatching	10	1.4 (0–6)	44 (27–66)
Pipped only	12	1.6 (0–3)	55 (22–110)
1 day after hatching	5	2.8 (0–7)	42 (30–62)
3 days after hatching	3	0	64 (30–105)
5 days after hatching	2	2.0 (0–4)	70 (32–94)

incubation, reaching its lowest level just prior to and at the time of hatching; there is no significant change after hatching. Numbers of relaxed muscle fibers decline gradually from the 15th day (67) to the 19th and 20th days (28 and 24, respectively) and then gradually become more numerous (70) on the 5th day after hatching. There was no observable difference in numbers of contracted fibers between chicks which pipped the shell but did not emerge and the chicks that hatched; but there were 25 per cent more relaxed muscle fibers per unit area in the "pipped" than in the "hatched" group.

Photographs (Plate 21) show the changes. In Figure 3 observe the numerous contracted fibers and the closely approximated muscle fibers. Note that contracted fibers are few after 17 days of incubation, and that there is a progressive separation of the bundles of fibers (Figs. 5–7) by the infiltration of lymph. By the 20th day (Fig. 7) the fibers are separated within the bundles, and lymph fills the central part of the muscle. Figure 8 shows that great infiltration is still present between and within the bundles of fibers; however, the centrally-located mass of lymph is not as obvious. The accumulation of lymph in the thin layer of connective tissue surrounding the muscle (Fig. 10) follows the same pattern. After hatching, there is a gradual decrease in lymph content until at least the 8th day, but the muscle already shows a nearly normal condition when the chick is five days old (Fig. 12).

Histological examination of the sections revealed that the cross-sectional area of muscle fibers was apparently less at 20 days of incubation (Fig. 7) when the greatest amount of lymph was present. Six of the nine chicks examined at this age showed this lesser area, but no quantitative studies were made of it.

Gross examination of the M. complexus in chicks which pipped the egg but did not emerge revealed diffuse to massive hemorrhages. Such bleeding occurred in 39 of 43 of these chicks, but in only 3 of 67 control chicks examined before or at the time of hatching. Microscopic examination of these tissues showed typical hemorrhages (Fig. 11). It is also interesting to note that, in these embryos which failed to hatch, the muscle fibers appear larger and closer together (Fig. 9) than in chicks of the same age that have hatched (Fig. 8).

Only 11 chicks emerged from the 24 eggs which had the experimental double shell; only one of the six eggs with cellophane tape hatched. In both these experiments the unbroken eggs contained fully developed chicks which in most instances were still alive at 22 days of incubation.

Twenty-seven of these 30 chicks showed slight to heavy hemorrhages in M. complexus. Two of the three chicks without the hemorrhages were ones that managed to hatch. It is possible, but not probable, that diffusion of oxygen was hindered by these procedures. However, this uniform hindrance could not account for the differential results obtained.

Five chicks in these series produced from two to four separate pips in attempting to hatch; two pipped the inner shell but were unable to break through the outer, added shell; and one pipped the shell in four places beneath the tape before finally breaking off the small end of the egg and backing out of the shell. The four pips were in a 220-degree arc around the larger end of the egg.

Discussion and Summary

Wet weight of the paired M. complexus increases rapidly, relative to body weight, at least from the 15th to the 20th day of hatching and with the major increase between the 18th and 20th days. Relative weight on the 21st day is approximately the same as on the 20th day, but there is a marked decrease in wet weight for three days after hatching, followed by a gradual decline at least until the 8th day of age.

In general these trends in size are similar to those reported by Pohlman (1919) for Rhode Island Red chickens. However, his graph (chart 1, p. 93) and Table 3 (p. 94) show the maximum weight on the 21st day. On page 98, he stated that ". . . the complexus muscle attains its maximum development at the twentieth day of incubation"; this is in agreement with the findings of the present study.

It is of at least momentary interest that the wet weights reported by Pohlman are less than those in this study, prior to hatching time, but agree well with the present ones for chicks one to eight days of

TABLE 3

WET WEIGHTS OF *M. complexus*

	Pohlman		*Fisher*	
Age	*mgms.*	*% body wt.*	*mgms.*	*% body wt.*
19 days incubation	234	0.46	428	1.57
20 days incubation	350	0.68	542	1.93
21 days incubation	656	1.44	456	1.85
1 day of age	416	1.09	473	1.16
2 days of age	325	0.87	376	1.04
3 days of age	262	0.76	247	0.63
5 days of age	150	0.39	135	0.28
8 days of age	95	0.27	135	0.27

age. I can see no significant explanation for the differences in weights during the incubation, since the post-incubation data agree. The most logical explanation is that Pohlman's 19-day chicks were really at 18 days of incubation (wts. for 18-day chicks in the present study averaged 234 mgms.). If this be the explanation, then the muscle reached its greatest size at 20 days in his chicks, not 21 days.

When the weight of the muscle is considered relative to body weight and the present data are compared to Pohlman's, there is close agreement after hatching, but inconsistencies prior to this time. Embryos in this study had muscles as large at 16 and 17 days as Pohlman's had at 20 days. Pohlman stated (p. 92) that his series represented ". . . roughly the 19th, 20th, and 21st day. . . ." Thus, I believe the present data, obtained from eggs laid within an eight-hour period, refrigerated overnight, and then incubated, provide a more accurate picture of development.

There can be little doubt as to the infiltration of lymph. Pohlman demonstrated this by comparing wet and dry weights of whole muscles, and weights of solids and of lymph. Counts of sections through muscle fibers show a decreasing number per unit area from the 15th through the 20th day of incubation, with a gradual increase thereafter until the 5th day of age when the fiber count is the same as on the 15th day of incubation. These changes are interpreted as results of lymph infiltration—first, between bundles of muscle fibers and, second, between fibers within a bundle—which forces the fibers apart.

Although the infiltration is evident in all muscles, it is most obvious in M. complexus. I have no explanation for this difference except to point out the presence of the pair of well-developed lymph glands which lie next to the lateral edge of each M. complexus. These glands follow a pattern of enlargement similar to that of the muscle, and I

cannot find any other lymph glands which even approximate the size of these.

Pohlman (1919:103) has postulated that the infiltration results from the absorption of the yolk sac, the resulting pressure, and perhaps an excretory malfunction. There seems to be little evidence for or against this theory.

The function of M. complexus, and even of the egg-tooth, has been questioned. Rosenstadt (1912) regarded the egg-tooth as a "phylogenetically old organ" which has "no particular physiological significance." Keibel (1912) thought M. complexus was the primary factor making the egg-tooth effective, but Pohlman (1919) believed that the infiltration of lymph was great enough to make the muscle ineffective. Although Daniel (1957:353) noted that the spinalis and biventer muscles were somewhat heavier in the Red-winged Blackbird than in the chick, he also observed that these muscles in the Red-wing are used in extending the head and neck when food is begged. If this be a primary function of these muscles, one would not expect their efficiency (measured by size) to decrease so soon after hatching. All evidence has been and is either speculative or circumstantial.

The coincidence of hatching and the best development of a transitory muscle may or may not be significant. The fact that the muscle in chicks which pipped the shell but did not emerge was significantly smaller than in just-hatched chicks seems to be important. It is a curious fact that there appears to be less infiltration of lymph in chicks which are fully developed and pip the egg, but do not hatch. If lymph does hinder the action of muscles, and if accumulated lymph is the factor hampering the activity of M. complexus, the muscle in these chicks should be better able to carry on its function; yet these chicks can not break out.

There are, of course, many other possible factors in failure to hatch. Further, hemorrhages in the M. complexus of these "picker" chicks and in the experimental series where additional shells or tape were added might indicate excessive strain when the muscle is being used to pip the egg. At the same time, it is possible that the increased pressure, postulated by Pohlman, ruptures the vascular capillaries. If so, why do these ruptures occur for the most part only in M. complexus?

Interpretation of the "contracted" muscle fibers is difficult. In Table 2 and in the photographs it is evident that their numbers decrease from the 15th to the 20th days of incubation, a period of time corresponding to the accumulation of lymph. This could be construed to mean that the lymph is "forcing" relaxation of the fibers,

which would support Pohlman's thesis of lymph hindrance. However, the number of these contracted fibers is apparently the same in the 21-day, just-hatched, and "picker" chicks, despite the lesser infiltration of lymph in the latter chicks. In addition, the "picker" chicks show a much greater proportion of their lymph in the connective tissue on the dorsal side of the muscle (Plate 21, fig. 10); here, it might be presumed, the pressure of the lymph and its effect on the fibers would be less than when the lymph is deeper and actually surrounding bundles and individual fibers.

Although the evidence is far from conclusive, my present belief is that the egg tooth ruptures the shell at hatching and that M. complexus provides the power.

SUMMARY

M. complexus is a muscle extending from the vertebral column to the dorsal surface of the head. Its action is to raise the head and bill. The muscle is apparent at 7 days of incubation, reaches its maximum size at 20 or 21 days of incubation, and then gradually disappears. This developmental history parallels that of the egg-tooth, which is thought to be effective in pipping the egg shell at the time of hatching. Histological study of the muscle and experimental procedures indicate that M. complexus is active at the time of hatching. It is believed that the muscle aids in forcing the egg-tooth against the shell.

Acknowledgments

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AN ANALYSIS OF MIGRATING BIRDS KILLED AT A TELEVISION TOWER IN EAST-CENTRAL ILLINOIS, SEPTEMBER 1955–MAY 1957

BY RICHARD BREWER AND JACK A. ELLIS

Birds killed at tall, dimly lighted structures such as television towers probably represent samples of nocturnal migration as nearly random as it is possible to obtain (see Tordoff and Mengel, 1956: 17–18). For this reason, study of these kills provides valuable data on such topics as relative numbers of each sex and age group of a species, time of migration of each group, fat condition, geographical patterns of migration, and total volume of migration. Information is presented on these topics in the following analysis of seven kills at the WCIA television tower located one mile west of Seymour in Champaign County, Illinois.

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Description of Tower and Surrounding Area

The WCIA tower is located in the NE ¼ of Sec. 18, T. 19 N., R. 7 E., of the Mahomet, Illinois, quadrangle. It is on a slight rise of 10 to 15 feet above surrounding land and 720 feet above sea level. The height of the tower is 983 feet, the upper 103 feet of which form a transmitting antenna. The antenna is composed of six segments, each 10.5 feet high, separated from one another by about 8 feet. The segments are cross shaped in cross-section and are 9 feet on a side. The lower 880 feet of the tower is triangular in cross-section with one of the eight-foot-wide faces directed north. This part of the tower is constructed of steel tubes 4.7 inches in diameter. L-beams 3 inches wide connect the legs every 8 feet, and small rods form diagonals between each set of cross-beams. Three groups of guy wires extending S 2° 40′ E, N 62° 40′ W and N 57° 20′ E support the tower. Each group is composed of three 1-inch cables attached at 280, 560, and 880 feet and anchored 600 feet from the base of the tower. The tower is supplied with red lights at seven heights as follows: 140 feet (3 steady), 280 feet (1 flashing), 420 feet

(3 steady), 560 feet (1 flashing), 700 feet (3 steady), 840 feet (3 steady), and 983 feet (1 flashing).

A transmitter building is situated 30 feet east of the tower. Incandescent lights placed eight feet from the ground at each corner illuminate the white sides of the building. Corn and soybean fields occupy most of the surrounding land. The floodplain of the Sangamon River, 2.5 miles to the west, is the nearest forested area.

WEATHER CONDITIONS DURING PERIODS OF MORTALITY

Mortality occurred under conditions of 80–100 per cent cloud cover, a ceiling of 400–1600 feet, and obscured visibility resulting from fog or haze. In general, mortality both in spring and fall was associated with the arrival of a cold front within the previous 12 hours. Temperatures ranged from 43° to 66° F. Wind was variable as to direction; wind velocity was between 5 and 10 mph. These are the same meteorological conditions which have been described for other examples of mass mortality, except for the variability of wind direction. Howell, Laskey, and Tanner (1954) found prevailing north winds during periods of mortality.

PROCEDURE

Notification of the four largest kills was received within 12 hours after each had occurred. The tower was visited within 24 hours after three of these and about 60 hours after the other (September 1955). For two fall kills and one spring kill, the locations of dead birds were mapped. Distances were determined by pacing from landmarks. Mapping was completed in one day except for the October 1955 kill which required parts of four days. Samples as nearly complete as possible were taken and the birds were frozen. Later examination involved verifying doubtful field identifications, sexing whenever possible, aging by means of skull ossification (for passerines), and determining fat condition (McCabe, 1943).

BEHAVIOR OF BIRDS AT THE TOWER

The usual cause of death in nocturnal mortality is collision with solid obstacles (Howell, *et al.*, 1954; Johnston and Haines, 1957). From information supplied by WCIA personnel, the actions of birds at this tower are similar to those described by Overing (1936) at the Washington Monument. Many birds seem to be killed in flight by collision with the tower or guy wires, but others are only stunned or injured. Of these, some die in hitting the ground. Some of those which reach the ground alive are killed by flying against the brightly lighted sides of

the transmitter building, but many survive and may be found the next morning in fields surrounding the tower.

NUMBERS OF BIRDS KILLED

Destruction of birds occurred at the WCIA tower on at least seven dates between September 1955 and June 1957 (Table 1). Four hundred eighty-six individuals of 51 species were counted. Mortality was ten times greater in fall than in spring. The largest number of birds were killed on the night of October 6–7, 1955, when a rapidly advancing cold front passed the tower about midnight.

The taxonomic pattern was similar to that reported in previous studies (*e.g.*, Johnston and Haines, 1957). Of the 16 families represented, wood warblers (Parulidae) were most numerous with 17 species and 70 per cent of all individuals. Also numerically important were the Fringillidae (8 species; 8 per cent of all individuals), the Vireonidae (4; 6), and the Turdidae (4; 5). The five most numerous species were Myrtle Warbler, Ovenbird, Palm Warbler, Tennessee Warbler, and Red-eyed Vireo.

Certain changes in species composition between the September 23–24 and the October 6–7, 1955, kills were noticeable. Swainson's Thrush, Magnolia Warbler, Ovenbird, and Rose-breasted Grosbeak showed greater numbers in the earlier kill. The reverse was true of Tennessee Warbler, Myrtle Warbler, and Palm Warbler, which were more numerous in the later kill. These changes reflect observable differences in times of migration of the various species.

COMPARISON WITH OTHER KILLS

To compare the species composition of WCIA samples with that of other examples of mass mortality, the following procedure was used: The ten most numerous species at WCIA and the ten most numerous species at another point were listed, with the exception that no species represented by fewer than five individuals was considered. The number of species common to the two lists was divided by the total number of different species. If 5 species were common to the two lists, then a total of 15 species would be represented, and the quotient (x 100) would be 33.3. This figure is the percentage of species (among the most numerous species) common to the two localities. It may be used as an index to the similarity of composition of the samples, taking into account in a general way both presence and abundance. On the basis of this index value, the WCIA fall 1955 samples are most similar to those from Tennessee and Georgia and least similar to those from Kansas (Appendix).

TABLE 1. BIRDS KILLED AT WCIA-TV TOWER SEPTEMBER 1955–MAY 1957.

Species	*Sept. 23–24, 1955*	*Oct. 6–7, 1955*	*May 6–7, 1956*	*Oct. 1–2, 1956*	*May 15–16, 1957*	*May 19–20, 1957*	*May 21–22, 1957*	*Total*
Pied-billed Grebe, *Podilymbus podiceps*	1							1
American Bittern, *Botaurus lentiginosus*		1						1
Mallard, *Anas platyrhynchos*			1					1
Blue-winged Teal, *Anas discors*				9				9
Sora, *Porzana carolina*		4						4
Common Gallinule, *Gallinula chloropus*		1						1
Mourning Dove, *Zenaidura macroura*			1					1
Black-billed Cuckoo, *Coccyzus erythropthalmus*	1							1
Yellow-shafted Flicker, *Colaptes auratus*		1						1
Yellow-bellied Sapsucker, *Sphyrapicus varius*	2	3						5
Yellow-bellied Flycatcher, *Empidonax flaviventris*	1							1
Least Flycatcher, *Empidonax minimus*	1							1
House Wren, *Troglodytes aedon*	1		1					2
Mockingbird, *Mimus polyglottos*			1					1
Catbird, *Dumetella carolinensis*	7	1						8
Brown Thrasher, *Toxostoma rufum*			1					1
Wood Thrush, *Hylocichla mustelina*	1							1
Swainson's Thrush, *Hylocichla ustulata*	13	6						19
Gray-cheeked Thrush, *Hylocichla minima*	1	2						3
Veery, *Hylocichla fuscescens*			1					1
Yellow-throated Vireo, *Vireo flavifrons*	3	1						4
Solitary Vireo, *Vireo solitarius*		1						1
Red-eyed Vireo, *Vireo olivaceus*	7	5	1		1	2	10	26
Philadelphia Vireo, *Vireo philadelphicus*	1							1
Black-and-white Warbler, *Mniotilta varia*	6	2	1					9
Golden-winged Warbler, *Vermivora chrysoptera*			1					1

TABLE 1 *(Continued)*

	9/23-24/55	10/6-7/55	5/6-7/56	10/1-2/56	5/15-16/57	5/19-20/57	5/21-22/57	Total
Tennessee Warbler, *Vermivora peregrina*	12	26			1			39
Magnolia Warbler, *Dendroica magnolia*	17	7	1					25
Myrtle Warbler, *Dendroica coronata*	2	76	1					79
Black-throated Green Warbler, *Dendroica virens*	4	4						8
Blackburnian Warbler, *Dendroica fusca*		2						2
Chestnut-sided Warbler, *Dendroica pensylvanica*	1	1			1			3
Bay-breasted Warbler, *Dendroica castanea*	2	8			1			11
Blackpoll Warbler, *Dendroica striata*	1	2			1	2		6
Pine Warbler, *Dendroica pinus*		2						2
Palm Warbler, *Dendroica palmarum*	5	39						44
Ovenbird, *Seiurus aurocapillus*	45	10			2			57
Northern Waterthrush, *Seiurus noveboracensis*		3	2					5
Yellowthroat, *Geothlypis trichas*	11	13						24
Canada Warbler, *Wilsonia canadensis*						1		1
American Redstart, *Setophaga ruticilla*	11	10	1					22
Bobolink, *Dolichonyx oryzivorus*	3							3
Scarlet Tanager, *Piranga olivacea*	8	1	2		1			12
Rose-breasted Grosbeak, *Pheucticus ludovicianus*	11	2	1					14
Dickcissel, *Spiza americana*			1		1			2
Savannah Sparrow, *Passerculus sandwichensis*	1	1						2
Grasshopper Sparrow, *Ammodramus savannarum*			2		1		2	5
Sharp-tailed Sparrow, *Ammospiza caudacuta*	1							1
White-throated Sparrow, *Zonotrichia albicollis*	3	1	2					6
Swamp Sparrow, *Melospiza georgiana*	2	3	1					6
Song Sparrow, *Melospiza melodia*	1	1						2
Total Species	33	32	19	1	9	3	2	51
Total Individuals	187	240	23	9	10	5	12	486

The WCIA samples differed from most others in the large number of Myrtle Warblers present. This species has been scarce or absent everywhere except at the WCIA tower and at New York City where 117 were recorded on October 19, 1955 (Nichols, 1956: 11). The scarcity of Myrtle Warblers in other samples is difficult to explain. Higher than usual populations might have existed in 1955, or the fact that it is a late migrant might somehow contribute to its rare appearance. Why lateness of migration should affect mortality is uncertain, but it is also true that birds which migrate earlier than most suffer little destruction. The Lousiana Waterthrush *(Seiurus motacilla)*, an early migrant, has been recorded no more than once or twice, although both the Ovenbird and the Northern Waterthrush are frequent victims.

SEX AND AGE COMPOSITION

Adult birds predominated in the fall kills. Seventy-nine per cent of the birds were adult in the September 1955 samples, and the preponderance was even greater (91 per cent) in the October sample (Table 2). All birds examined from spring accidents exhibited complete skull ossification.

Only two species were well-represented both in fall kills at Topeka, Kansas (Tordoff and Mengel, 1956: 14, 23) and those of the present study. These two, Ovenbird and Yellowthroat, showed greater per-

TABLE 2

AGE RATIOS OF 12 SPECIES OF BIRDS KILLED SEPTEMBER 23-24, 1955 AND OCTOBER 6-7, 1955

	September 23–24, 1955		*October 6–7, 1955*	
	Number	*Age Ratio*	*Number*	*Age Ratio*
Species	*Examined*	*Adult:Immature*	*Examined*	*Adult:Immature*
Swainson's Thrush	4	2:2 (1 ♀)	6	4 (1 ♂) :2 (1 ♀)
Red-eyed Vireo	5	4:1	2	2:0
Black-and-white Warbler	2	2 (1 ♀) :0	2	1:0
Tennessee Warbler	5	5:0	17	16 (1 ♂, 5 ♀) :1
Magnolia Warbler	8	8:0	7	7 (2 ♀) :0
Myrtle Warbler	1	1:0	38	38 (4 ♂, 6 ♀) :0
Bay-breasted Warbler	1	1:0	4	4:0
Palm Warbler			31	31 (2 ♂, 8 ♀) :0
Ovenbird	16	14 (5 ♀) :1	10	7 (1 ♂) :3 (1 ♀)
Yellowthroat	11	9 (1 ♂, 1 ♀) :1 (♂)	5	4:1
American Redstart	4	4:0	5	5 (4 ♂) :0
Swamp Sparrow	2	0:2 (♀)	2	1 (♀) :1
Totals (32 species)	78	59 (4 ♂, 9 ♀) :16 (1 ♂, 6 ♀)	141	128 (15 ♂, 22 ♀) :12 (2 ♂, 1 ♀)

centages of adult birds in the samples from Illinois. The differences in both species were significant at the 1 per cent level (Table 3). An explanation of this apparent difference in age representation should await additional studies of mass mortality from other areas and other dates.

Deterioration of gonads of birds frozen for considerable periods made sexing impossible for much of the fall sample. Of the autumn-killed birds for which sex could be determined, the greater number were females. Males represented only 33 per cent of 24 birds from the September 1955 kill and only 44 per cent of 43 birds from the October kill (Table 2). Sex ratios differed greatly between the two spring kills. For the May 6–7, 1956, kill, 8 (73 per cent) of the 11 birds were males,

TABLE 3

COMPARISON OF THE RATIO OF ADULTS TO IMMATURES OF OVENBIRD AND YELLOWTHROAT IN FALL 1954 MORTALITY IN KANSAS (TORDOFF AND MENGEL, 1956:14,23) AND FALL 1955 MORTALITY IN ILLINOIS

	Number and Frequency						
	Number		*Adults*				
Species	*Kansas*	*Illinois*	*Kansas*	*Illinois*	*Difference*	$S.E._{D\ \%}$	*P*
Ovenbird	30	25	10 (0.333)	21 (0.840)	0.507	0.134	0.00006
Yellowthroat	159	15	82 (0.516)	13 (0.867)	0.351	0.134	0.009

whereas nearly equal numbers (47 per cent males) were found among 15 birds killed May 15–22, 1957.

FAT CONDITION

Migratory birds generally undergo fat deposition in the fall and spring, presumably as an adaptation for sustaining migratory flight. The fact that most birds examined were rated from moderately to excessively fat (Table 4) is, therefore, expected. Of the four species well represented on both September and October 1955 kills, Ovenbird and Yellowthroat showed no change in fat condition, and Magnolia Warbler and Tennessee Warbler were judged to be fatter on the October kill. The same statement, that in the later kill there was either an increase in fat or no change, characterizes nearly all of the species common to the two kills.

A similar trend of increasing fatness later in the season may be present in the spring kills, but the samples are small, and the determinations for birds killed in 1957 were made by personnel other than the writers. The subjectiveness of the method makes comparisons uncertain both in this case and also between birds common to this study and

TABLE 4

FAT CONDITIONS OF 15 SPECIES OF BIRDS KILLED ON FOUR DATES, 1955-1957. NUMERALS REFER TO THE FAT CLASSES OF MCCABE (1943) AS FOLLOWS: 0—NO FAT; 1—LITTLE FAT; 2—MODERATE FAT; 3—FAT; 4—VERY FAT; 5—EXCESSIVELY FAT

	September 23-24, 1955		*October 6-7, 1955*		*May 6-7, 1956*		*May 15-22, 1957*	
Species	*Range*	*Modal Class*	*Range*	*Modal Class*	*Range*	*Modal Class*	*Range*	*Modal Class*
Yellow-bellied Sapsucker	3-5		5	5				
Swainson's Thrush	2-5		3-5	5				
Red-eyed Vireo	5	5	4-5		2		4-5	5
Black-and-white Warbler	2-5		2-4		4			
Tennessee Warbler	4-5	4	3-5	5			5	
Magnolia Warbler	0-5	2	4-5	5	2			
Myrtle Warbler			1-5	4	3			
Bay-breasted Warbler			4-5	4			5	
Palm Warbler			2-5	5				
Ovenbird	3-5	5	2-5	5			5	
Yellowthroat	1-5	4	2-5	4				
American Redstart	2-4		2-5	4	5			
Scarlet Tanager	4-5		4		1-3		5	
Rose-breasted Grosbeak	4	4	3	3				
Swamp Sparrow	0-3		3-4					

to that of Tordoff and Mengel (1956). In general, birds were rated fatter in Illinois than in Kansas. This was probably the true situation in such an extreme example as the Ovenbird: Of 30 Ovenbirds from Kansas, none was rated more than very fat, whereas 10 out of 26 from Illinois were considered excessively fat.

LOCATIONS OF DEAD BIRDS

The distribution on the ground of birds killed in flight depends on the speed, height, and direction of flight, the obstacle struck, and the velocity and direction of the wind. Mapping this distribution allows an assessment of the relative roles of the tower and the guy wires in accounting for mortality and may provide information as to what species were migrating together, or at least during the same period of time.

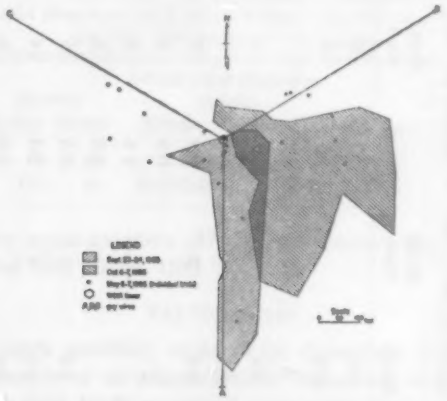

FIGURE 1. Distribution of dead birds around WCIA tower in 3 kills, 1955–1956. Birds separated by more than 100 feet from all other birds were not included in the September and October 1955 outlines.

The pattern of distribution in the September 1955 kills (Figure 1) is explainable by assuming that most of the birds were killed by striking the tower while they were flying south. The most reasonable explanation of the patterns found on the October 1955 and the May 1956 kills, however, is that a fair proportion of the birds hit the guy wires rather than the tower itself.

The greatest number of dead birds in the September 1955 kill were found between 75 and 150 feet from the tower, but a second area of concentration appeared between 450 and 525 feet. This bimodal dis-

tribution may have resulted from birds being killed high on the tower at two different times when wind velocities were different. It seems unlikely that the two areas of concentration represented birds flying at two different altitudes because if low-flying birds had been present, some should have collided with guy wires. If the two areas of concentration did result from differing wind velocities at different times during the night, then the species found together in an area of concentration should be a sample of those migrating at the same time. Under this assumption, Catbird, Swainson's Thrush, Red-eyed Vireo, Ovenbird, American Redstart, and Rose-breasted Grosbeak, all found in both areas of concentration, were migrating throughout the period when birds were killed. Palm Warblers, present only in the area of concentration 500 feet from the tower, were migrating at a different time from Black-and-white Warblers, Tennessee Warblers, Yellowthroats, and Scarlet Tanagers, which were found only in the peak 150 feet from the tower.

CALCULATIONS OF NUMBERS OF MIGRANTS

Under certain conditions, a satisfactory index value to the total volume of migration through an area during one night can be obtained from the numbers of birds killed at a television tower. One attempt has been made to obtain such a value. Tordoff and Mengel (1956: 18–20), using data from a 950-foot tower near Topeka, Kansas, have calculated the number of migrants passing through a plane extending one mile horizontally and from 450 to 950 feet from the ground. The procedure involves setting up a proportionality between (a) the number of birds killed and (b) the area of the tower and guy wires above 450 feet and (c) the total number of birds passing through the plane and (d) the total area of the plane. The 450-foot lower limit was chosen because during periods of mortality only a few birds struck a nearby 500-foot tower.

It is clear that the figure obtained by this procedure is subject to several sources of error. The following conditions tending to produce an erroneously low estimate were probably all present: (1) avoidance of the tower by birds flying toward it (see Tordoff and Mengel, 1956: 17), (2) recovery of birds merely stunned in striking the tower, and (3) failure of observers to find all of the birds killed. Based on the numbers of live birds around the WCIA tower on mornings after kills, 15 per cent of the individuals striking the tower may survive. That this figure may be sometimes much higher is suggested by observations of R. R. Graber (personal communication). On several occasions, he has heard birds collide with the tower (five or more during one night) and failed

to find any dead birds around the tower the following morning. We have estimated that only 85 per cent of all dead birds were found at WCIA, the rest being overlooked or lost to scavengers.

If these three were the only sources of error, the procedure followed by Tordoff and Mengel would provide a satisfactory index in the form of a minimum estimate. The estimate may be of a little value, however, if two conditions tending to produce erroneously high estimates are present. These conditions are: aggregation of birds in migration and attraction of them to the tower. Tordoff and Mengel have cited the work of Stone (1906: 250–251) and Lowery (1951: 409–413), indicating uniform distribution of night migrants, and have suggested that attraction of migrants by the tower is ruled out by the fact that tall towers do not cause mortality on clear nights and low ones do not cause mortality even on stormy nights.

Aggregation. We believe that aggregation of birds in migration may be pronounced. Ball has stated (see Lowery and Newman, 1955: 246) that in his study of migrating thrushes by means of flight-call counting, grouping did occur. Furthermore, Lowery's assertion that night migrants exhibit a uniform horizontal distribution was based for the most part on work done in the spring; Lowery and Newman have since stated (1955: 247) that the fall flight is not as consistently dispersed. It is interesting that nocturnal mortality is much more frequent and involves larger numbers in fall than in spring. (Undoubtedly, two other factors also enter: there actually are many more migrating birds in the fall, and cold fronts, which produce the weather conditions associated with mortality, slow rather than hasten migration in the spring.) Finally, the distribution of dead birds in the October 1955 kill, in which birds appeared to have struck the tower and guy wires to the east of the tower, but not the guy wires to the west (Figure 1), can be interpreted as indicating extreme aggregation.

Aggregation of birds in migration could be either of a "fly-line" sort, in which a stream of birds follows some topographic, or other, feature, or it could express itself as a clumping of migrants, with the clumps themselves randomly or evenly distributed. The problem in either case is an increase in the variation in numbers of birds killed. If birds are aggregated, some towers may kill many birds, others few, and still others none. If strictly accurate predictions could be made of nights when mortality should occur and if estimates of none or a few thousand birds were reported along with those of several hundred thousand, the combined results would give a relatively accurate index to the total volume of migration.

Attraction. The most serious potential source of error is attraction

of birds to the tower. Our only evidence concerning attraction is provided by personnel of the WILL-TV tower about five miles southwest of Monticello, Illinois. In climbing that tower during spring or fall, they often found dead birds lodged in the structure but these were always on levels away from the lights. It appears that, at least at short range, the birds tended to avoid the lights rather than to seek them. Cochran and Graber (1958), however, have presented evidence, based on flight-call counting and spot-lighting, which is strongly suggestive of a concentration of migrants around the WCIA tower. This concentration, occurring only on nights of low ceilings, appeared to decrease when the tower lights were extinguished.

Estimates. We have calculated the numbers of migrants through a plane one mile long, centered on the WCIA tower, for the nights of September 23–24, 1955, and May 6–7, 1956. Lower limits for the plane were 560 and 455 feet from the ground, respectively (based on positions of dead birds under the guy wires). For the September 1955 kill, the proportionality, in which X is the number of birds passing through the plane, is

$$187/1{,}027 = X/2{,}233{,}440.$$

The figure 1,027 is the square feet of solid surface above 560 feet which the tower, antenna, and guy wires would present to oncoming migrants (calculated from blueprints). On the basis of this proportionality, 406,670 birds passed through the mile-long plane between 560 and 983 feet from the ground on this night. Of these, 97,860 were Ovenbirds.

For the May 1956 kill, the proportionality is

$$23/1{,}437 = X/2{,}787{,}840.$$

The total number of birds passing through the one mile plane between 455 and 983 feet from the ground on this night, then, was 44,620.

The need for direct, quantitative information on aggregation of migrants and their attraction to towers cannot be over-emphasized. Until such information is available, caution should be taken in the use of index figures such as are presented here.

SUMMARY

1. On seven dates between September 1955 and May 1957, migrating birds were killed at the 983-foot WCIA television tower in Champaign County, Illinois. Mortality was ten times greater in fall than spring.

2. Kills occurred under conditions of 80–100 per cent cloud cover, a ceiling of 400–1600 feet, and obscured visibility. Generally, a cold front had passed the point of kill within the previous 12 hours.

3. 486 individuals of 51 species were counted. 267 were examined to determine fat condition and age and sex ratios.

4. Among the 16 families represented, wood warblers were most numerous both from the standpoint of total individuals and species. The five most numerous species were Myrtle Warbler, Ovenbird, Palm Warbler, Tennessee Warbler, and Red-eyed Vireo, in that order.

5. Changes in specific composition between two kills separated by 13 days in the fall of 1955 were related to observable differences in times of migration of the various species.

6. Based on percentage similarity of the ten most numerous species, the east-central Illinois sample is most similar to samples from Tennessee and Georgia, and least similar to those from Kansas.

7. Dead birds, even in the fall, were predominantly adults. Ovenbirds and Yellowthroats showed greater percentages of adult birds in samples from Illinois than in samples from Kansas.

8. Of the fall birds for which sex was determined, the greater number were female. Males predominated in the May 6–7, 1956, kill, and an approximate 1:1 ratio prevailed in the May 15–22, 1957, kill.

9. Most birds examined were moderately to excessively fat. Of species common to the two fall kills (September and October), there was either an increase in fat or no change on the later kill.

10. Index values to total volume of migration based on numbers of birds killed at television towers are subject to several sources of error. The values may be useful as minimum estimates, if there is no aggregation of birds in migration or attraction of them to the tower. In the absence of conclusive evidence that these conditions do not exist, figures so obtained should be used with caution.

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APPENDIX

PERCENTAGE SIMILARITY OF SOME EXAMPLES OF MASS MORTALITY TO FALL 1955 MORTALITY AT THE WCIA-TV TOWER

Location	*Date*	*Percentage similarity*	*Reference*
Empire State Building New York, N. Y.	Sept. 10–11, 1948	26.6	Spofford 1949
Washington Monument Washington, D. C.	Aug. 28–Oct. 24, 1935	8.3	Overing 1936, 1937
Washington Monument Washington, D. C.	Aug. 17–Oct. 23, 1936	35.7	Overing 1937
Washington Monument Washington, D. C.	Aug. 27–Oct. 30, 1937	33.3	Overing 1938
Ceilometer Knoxville, Tenn.	Oct. 7–8, 1951	33.3	Howell 1955
Ceilometer Knoxville, Tenn.	Oct. 6–7, 1954	33.3	Howell 1955
Lighted parking lot Oak Ridge, Tenn.	Oct. 6–7, 1954	33.3	Dunbar, *in* Tanner *et al.*, 1954

Ceilometer Chattanooga, Tenn.	Oct. 6–7, 1954	33.3	West, *in* Tanner *et al.*, 1954
Ceilometer Nashville, Tenn.	Sept. 9–10, 1948	17.6	Spofford 1949
Ceilometer Nashville, Tenn.	Oct. 7–8, 1951	33.3	Howell 1955
Ceilometer Nashville, Tenn.	Oct. 6–7, 1954	26.7	Howell 1955
Ceilometers Nashville and Smyrna, Tennessee	Sept. 24–25, 1955	42.8	Laskey 1956a
TV tower Nashville, Tenn.	Oct. 5–19, 1956	15.4	Laskey 1956b
Ceilometer Smyrna, Tenn.	Oct. 6–7, 1954	21.4	Laskey, *in* Tanner *et al.*, 1954
TV tower Atlanta, Ga.	Oct. 6–7, 1954	25.0	Johnston 1955
TV tower Augusta, Ga.	Oct. 7–8, 1954	23.1	Johnston 1955
Ceilometer Warner Robins, Ga.	Oct. 6–8, 1954	42.8	Johnston 1955
Several sources Savannah, Ga.	Oct. 7–8, 1954	35.7	Johnston 1955
Ceilometer near Savannah, Ga.	Oct. 7–8, 1954	25.0	Johnston 1955
Radio tower Camp Cornelia, Ga.	Oct. 7–8, 1954	33.3	Johnston 1955
Ceilometer near Albany, Ga.	Oct. 7–8, 1954	33.3	Johnston 1955
TV tower Eau Claire, Wis.	Sept. 2–20, 1957	33.3	Kemper 1958
TV tower near Topeka, Kansas	Sept. 24– Oct. 23, 1954	11.1	Tordoff and Mengel 1956
TV tower near Topeka, Kansas	Sept. 10– Oct. 8, 1955	17.6	Carson 1955

ON REGIONAL MOVEMENTS AND BODY WEIGHT OF BLACK-CAPPED CHICKADEES IN WINTER

BY LOUISE DE KIRILINE LAWRENCE

At Pimisi Bay, on the 46th parallel in central Ontario, the return records of banded Black-capped Chickadees (*Parus atricapillus*) suggested considerable movement among the winter populations. Other workers have found this to be true, notably Odum (1941, 1942) and Blake (1952). A connection seemed to exist between the pattern of these movements and the recurring reports in certain years of large concentrations of migrating chickadees south of Pimisi Bay, from the Atlantic coast westward. It occurred to me, therefore, that an investigation might be of interest into the changes in weight and fat deposition of the chickadees and the similarity, if any, of these processes with those taking place in certain true migrants; *e.g.*, the White-throated Sparrow (*Zonotrichia albicollis*) and the Slate-colored Junco (*Junco hyemalis*) as found by Wolfson (1942, 1953, 1954) and Odum (1949). This study was begun in the fall of 1948 and continued during five years until the spring of 1954.

Acknowledgments

My thanks are due the Northwestern University for the loan of a balance and the Canadian Department of National Revenue for arranging its duty-free entrance into Canada. The Department of Transport of Canada kindly supplied the records of the nearest weather station at North Bay, upon which the data and discussions of the weather conditions are based. Dr. Lars von Haartman's help with the calculation of the standard deviation and Dr. J. M. Speir's assistance with the checking and arrangement of the data I gratefully acknowledge. For the encouragement and guidance given me by Dr. Albert Wolfson and Mrs. Margaret M. Nice throughout this enterprise I am deeply indebted.

Methods

The research was conducted during the winter half-years from August-September to April-May. Efforts were made to handle every chickadee, returns as well as new birds, which frequented the feeding-station. With the exception of the period from October 1953 to March 1954, when opportunity to weigh the birds was lacking, it is possible to say that few of our chickadees escaped being caught each winter.

Often 50 to 60, once 78, chickadees were handled in one day, representing practically all present in the neighborhood at that time. A

dab of scarlet nail-polish was applied to the white edgings of the primaries of each chickadee handled. Those that escaped capture showed up plainly. They seldom exceeded half a dozen. The red marking, or traces thereof, endured throughout the season.

At first two Potter's and two automatic trip traps were kept working all the time. However, the birds soon became more and more difficult to re-catch in this way, since they developed either fear of the traps or learned how to avoid tripping them. For this reason all-day trapping sessions were introduced, covering most half-month periods of the six years, during which a minimum of food was made available except in the traps. This worked well taking all considerations into account, such as the varying experience, the difference of individuality, and the rhythm of the daily activities of the birds. Usually the inexperienced new arrivals filled the traps from early morning until well into midday while, the more the afternoon advanced, the greater the number of "repeats" until during the last hour before roosting time even the most stubbornly evasive of the experienced chickadees could be expected to yield a record.

All weighings were done on a Cenco balance to the tenth of a gram. To immobilize the birds paper cones were used. These cones were weighed before, after, and sometimes during a session because the humidity of the air and dirt accumulating influenced their weight. The bird's net weight was recorded. No bird died during the process.

Sex determination.—Three criteria were used to determine sex: 1) wing-length, 2) vocal notes, and 3) behavior.

For obvious reasons only color-banded birds came into the last category.

When being handled certain chickadees often emitted a special protesting cry similar to, if not identical with, the "hissing" sound given by the females when disturbed on the nest. With the exception of 4 birds which were placed in the "undetermined sex" group, none of the chickadees classed as males, with wings measuring 66 mm. and over (see below), gave this note.

All wing measurements were taken from the bend to the tip of the longest primary without flattening the folded wing (Wolfson, *in litt.*). Odum's (1943:178) standards for sex differentiation according to wing-length was followed, *i.e.*, males—66 mm. and over, females—63 mm. and less, undetermined sex—over 63 to 66 mm.

Wing-lengths ranged from 61 to 71 mm.; the average of 573 measurements was 65.8 mm. Many chickadees showed noticeable shortening of their wing-lengths through wear from fall to spring, often as much as one to two millimeters. The average of 285 measurements taken in October, November, December, and January, was one-half millimeter longer than that of 288 taken during February, March, and April.

Fat determination.—The amount of visible subcutaneous fat was also recorded at each weighing. The principal body areas observed were the *abdomen*, usually filling first in the chickadees, the areas around the wish-bone (*furculum*), and under the wing (*axilla*), the last place to fill out except in birds in very heavy fat.

According to the classifications worked out for the Oregon Junco (*Junco oreganus*) and the White-throated Sparrow (Wolfson, 1945:109; 1954:415), the amounts of fat were divided into 4 classes:

1) None—no fat visible or only slight traces in some or all regions;
2) Little—fat seen in area of *furculum* or abdomen, small amounts elsewhere;
3) Medium—*furculum* or abdomen full, puffiness in other regions;
4) Heavy—*furculum* or abdomen overflowing, swollen, other regions full.

The variation of the coloring of the fat in the chickadees was, at first, a puzzling discovery. It ranged from orangy yellow to creamy white. Not until I had seen the hourly variations in weight and fat deposition in a number of chickadees did I realize the apparent reason for this difference. Fat that was in the process of being replenished gradually changed from yellow to white and, conversely, that being depleted from white to yellow. While it was not always possible to determine whether the fat in a particular chickadee was being laid on or lost, the observation was of help sometimes in deducing the probable movements of the bird. For instance, a chickadee with more white than yellow fat might be laying it on prior to departure and this could then be either confirmed by the bird's disappearance or disproved by its next retake.

In all, 1279 weight records were obtained from 340 chickadees of which 113 were males, 154 females, and the sex of 73 could not be determined. Of all these 197 were weighed once or only during one half-year, whereas 143, or 42 per cent, were weighed during more than one season, many of them several times each winter. One female disappeared at 9 years of age after having given 5 records in 8 winters and another gave 19 records in the course of 5 winters.

The Yearly Variations of Winter Populations

With the exception of four species, the Pileated Woodpecker (*Dryocopus pileatus*), the Hairy Woodpecker (*Dendrocopos villosus*), the Great Horned Owl (*Bubo virginianus*), and the Ruffed Grouse (*Bonasa umbellus*), the term permanent resident is applied correctly only to birds of other Pimisi Bay species whose permanency of residence was evidenced by marking.

Most of the Black-capped Chickadees accommodated on the nesting-grounds within about half a mile of the feeding-station proved to be year-round residents. Even among these, certain color-marked birds were not domiciled in the area continuously, but were there one year and gone the next.

If by migration is meant any movement from one area to another, by far the greater part of the chickadees concentrating at Pimisi Bay at one time or another during the winter were migratory. How far they went and how great distances they came from are other questions. None of the over 500 chickadees I banded were retrieved elsewhere. I did not encounter any of these banded birds farther away from the feeding-station than one-half mile, nor were they reported seen at neighboring feeding-stations beyond that distance. Obviously, a considerable number of the chickadees wintering at Pimisi Bay travelled some way to reach this area in which a stable supply of artificial food was to be found, in addition to the natural resources. However, lacking this special supply, doubtless the chickadees would have been even more mobile and dispersed.

So far as I could discover, most of the winter-resident chickadees did not breed in the territory around Pimisi Bay that I could reach on foot beyond the half-mile radius of the feeding-station. On the other hand, wide areas north and east, stretching more than a hundred miles into northern Ontario and across the Ottawa River into Quebec, contained chickadee habitats of the best kind, of which even the closest ranges could well absorb vastly greater numbers of chickadees than appeared yearly at the feeding-station.

Odum (1941:529) described the winter feeding ranges of the Black-capped Chickadees at Rensselaerville, New York, as extending over from 21 to 55 acres, averaging 36 acres, and noted that the birds concentrated around the feeding-stations. Blake (1952:167) observed large numbers of moving chickadees during the winter in Massachusetts. "Even though the distances travelled may be small, I would regard these moving birds as true migrants especially since they are not seen again."

Figure 1 presents an analysis of the number of wintering and transient chickadees based on captures and re-captures during the winters 1948 to 1953 in relation to the approximate mean temperature of the three summer months in these years.

Birds taken within the same month as they were first captured but not again, and those not retaken during the same season are considered transients. Those retaken once or several times during the winter, including those which arrived in January and were re-captured

in March, are counted as wintering. A few may, of course, have escaped capture but not in sufficient numbers to alter significantly the picture of the diagram. The winter 1948-49 is not included because the study was not yet fully organized at that time.

During the winters 1949-50, 1950-51, and 1952-53, as can be seen, the chickadee populations maintained fairly constant near-the-peak levels, although the number of wintering chickadees in 1950-51 declined rather sharply. Except in 1950 and 1951, the mean temperatures of the other three summers were high and, significantly, there were no reports of any major movements of chickadees south of Pimisi Bay in the fall and winter following these three summers.

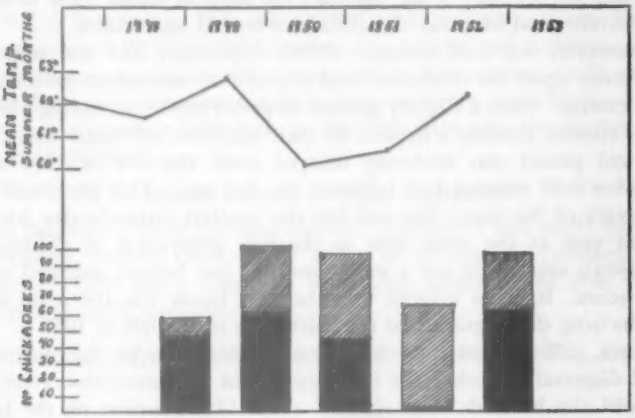

FIGURE 1. The number of wintering and transient chickadees, 1948-1953, in relation to the approximate mean temperature of the three summer months. Black denotes wintering bird; hatching denotes transients.

In the winter of 1951-52, on the contrary, a sharp decline occurred at Pimisi Bay especially in the number of wintering chickadees. During the end of August and the first week of September an unusual influx of chickadees was noted, but they vanished again soon after. During November returning chickadees, chiefly, arrived in rather greater numbers than usual (see next section) and most of these were *not* again retaken in that season. With scattered birds coming and going, and including the spring concentration in March, the average counts of the chickadees throughout that winter remained relatively low.

Without a doubt, these observations at Pimisi Bay stood in close relation to the great incursion of chickadees reported in *Audubon*

Field Notes (1952) from the Hudson-St. Lawrence and Ontario-Western New York regions for the fall of 1951. In his summary for this period Ludlow Griscom (1952:4) said: "Black-capped Chickadees, extraordinary flood through southern Ontario (up to 1400 in a day)."

What caused the spectacular migration in this particular year? It is to be noted that the summer of 1950 was exceptionally sunless and cold and the season of 1951 no less so, with a mean temperature for June, July, and August, less than a full degree higher. Cold and sunless summers affect the numbers and survival of the insects which constitute 68 per cent of the Black-capped Chickadee's food, according to examined stomachs (Odum, 1941, quoting Forbush). Cold also reduces the fruition of the conifers, the seeds of which form another important food item for the chickadee in fall and winter.

However, one cold summer (1950) apparently had not sufficient influence upon the chickadee food situation to necessitate an immediate exodus. Only a slightly greater dispersal of the wintering chickadees ensued, causing a decline in their numbers at Pimisi Bay. The critical period was evidently delayed until the fall of 1951 after another cold summer had followed the first one. This prevented the recovery of the insect life and left the conifers unproductive for another year at the same time as the new generation of chickadees, although apparently not a numerous one (see below), emerged upon the scene. It seems evident that the food factor was the main issue underlying the migration of the chickadees in the fall of 1951.

Lack (1954) maintained that the ultimate reason for the movement and dispersal of birds is the food supply. In this connection reference should also be made to Koskimies' (1955:17) discussion on the influence of the "food limit" upon cyclic and irruptive species, especially in the north.

According to the present study, immediate weather conditions, such as cold spells, appeared to have little bearing on the movements of the chickadees, at least insofar as they were of noticeable proportions. Obviously these hardy little birds could endure severe winter weather without special difficulty, provided they were in good health and able to roost with full stomachs. We shall return presently to the last condition.

Odum (1942:156) found that high temperatures in April when the breeding season started not only increased nesting success but also promoted double broods. In 1941, this apparently created a population pressure in New York State which, he suggested, was an important factor in the irruptive southward migration of Black-capped Chickadees which occurred in the fall of that year.

At Pimisi Bay, however, the spring preceding the cold summer of 1950 was late and cold. Snow still covered the ground on April 23 and the ice went out of the lake at the record late date of May 6. The same was the case in 1951 when snow remained on the ground up to April 20 and northerly winds prevailed almost incessantly from the last of April to May 14.

If an early spring and good weather are significant factors in producing a nesting success high enough to create population pressure, these conditions were entirely lacking at Pimisi Bay both in 1950 and 1951. The late emergence and the small numbers of fledglings recorded in those years indicate a minimum reproductive increase. The migration in the fall of 1951, of which the first signs were recorded at Pimisi Bay (see p. 419), must therefore have been initiated by another factor in these northern regions, *i.e.*, failing food supplies resulting from two successive late springs and cold summers. Only as the great flocks of chickadees reached more southerly parts might actual population pressure have become the chief factor in the further dispersal of the birds.

Monthly Variation in Winter Populations

In the years 1948-54 the total number of returned and newly banded chickadees showed three major peaks in November, January, and March. There was a fourth in September consisting of new birds, probably mostly juveniles.

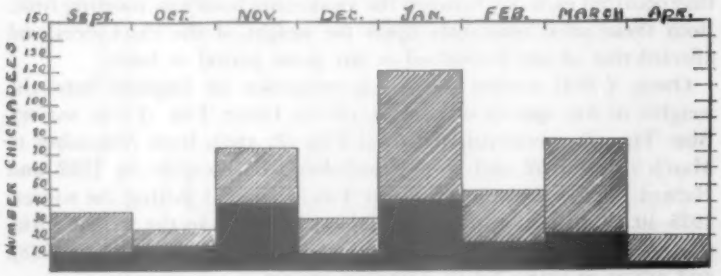

FIGURE 2. Total number of banded chickadees, 1948-1954. Solid black denotes returns; hatching denotes newly banded.

The returned chickadees were most numerous in November and likely this early return to the wintering ground is related to some of these birds being guided by memory back to the previously known locality of the feeding-station. Occasionally two chickadees, originally caught on the same day, would be retaken together in another year,

suggesting a certain attachment between some of them beyond the breeding season. Nice (*in litt.*) made the same observation in the Carolina Chickadee (*Parus carolinensis*). Eighteen per cent of the wintering chickadees arrived in November.

When added together, the total number of chickadees for January was higher than in any other month of the half-year, although the influx did not always reach its peak at this time every winter. Apparently a climax dispersal generally occurred in mid-winter. This contention is also supported by the fact that most of the January arrivals were new birds. Forty-five per cent of the chickadees that stayed the rest of the winter came in January.

The March peak represented the chickadees' spring migration back to the breeding-grounds. As might be expected, the new birds were also here in the majority.

In the Toronto area several wintering species, notably the Tree Sparrow (*Spizella arborea*) and the Snow Bunting (*Plectrophenax nivalis*), both of which are true migrants with fall and spring peaks, show this "three-peak-phenomenon" (Speirs, *in litt.*), the mid-winter peak being attributed to the aggregation of large numbers in favorable feeding areas.

Variations in Average Weights

Two main trends emerged in the variations of the average weights of the chickadees—the fluctuations from month to month and those that occurred each day between the awakening hour and roosting time. Both these acted constantly upon the weight of the chickadees and affected that of any individual at any given period or hour.

Owen (1954) carried out an investigation in England into the weights of five species of titmice, chiefly Great Tits (*Parus major*), Blue Tits (*P. caeruleus*), and Coal Tits (*P. ater*), from November to March in 1951–52 and from November to December in 1952 and Haftorn (1951) worked with Great Tits in Norway during the winters 1935–40. Both demonstrated the same two trends in the weight variations of their birds, as did Baldwin and Kendeigh (1938), Nice (1938), and others in many North American species.

The chickadees showed an average difference in weight between the sexes of a little over a gram, the males being heavier than the females. The greatest and smallest male weights were 14.3 and 10.5 gms., female 13.8 and 9.5 gms. Some individuals, irrespective of sex, were constantly much heavier than others.

TABLE 1

AVERAGE WEIGHTS OF THE BLACK-CAPPED CHICKADEES, 1948-1954

Month	Males No weights	Average grams	Range grams	Standard deviation	Females No weights	Average grams	Range grams	Standard deviation
Aug.-Sept.	13	12.1±0.08	11.3–12.5	0.30	25	10.9±0.11	10.0–12.0	0.52
Oct.	14	12.0±0.10	11.2–12.5	0.35	23	11.1±0.12	10.3–12.2	0.57
Nov.	43	12.3±0.08	11.3–13.8	0.55	62	11.1±0.11	9.8–12.8	0.91
Dec.	32	12.5±0.10	11.7–13.9	0.60	35	11.3±0.05	10.4–12.6	0.28
Jan.	88	12.6±0.06	10.5–14.0	0.58	128	11.3±0.05	9.5–12.8	0.54
Feb.	60	12.7±0.08	11.8–14.3	0.62	83	11.5±0.08	9.9–13.0	0.71
March	136	12.4±0.05	11.0–14.3	0.61	218	11.4±0.06	9.7–13.8	0.82
April	48	12.4±0.08	11.3–13.9	0.56	79	11.3±0.08	9.7–13.1	0.71
May	1	14.0			6	11.9	10.6–12.8	
	435	12.5	10.5–14.3		656	11.3	9.5–13.8	

The Influence of Migratory Movements

Table 1 shows the average monthly weights for the years 1948–54.

Beginning in October, a steady rise in weight ended in a peak in December and was thereafter followed by a slight decline in January and a climax rise again in February. The weights in March and April-May were as high as in January (see Figure 3). In the males the weights rose steadily to the February peak, dropped in March and levelled off in April. In the females the rise to the February peak was less steep and there was a decline in April.

It will be noted that the peaks of the weights show a certain correlation with the times of greatest influx of the chickadees. This became

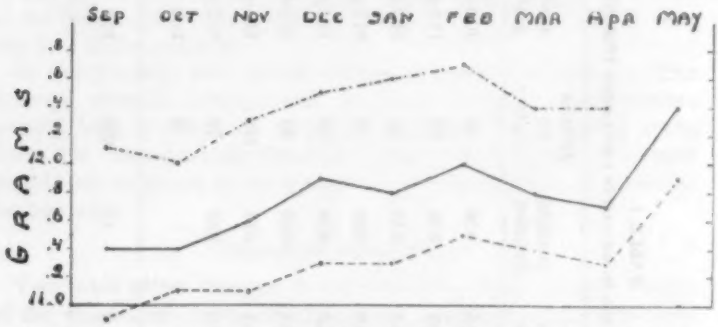

FIGURE 3. The average monthly weights of the males, the females, and the total number chickadees, including those of undetermined sex. Males —·—. Females – – – –. All birds ———.

still more marked when the weights were computed in half-monthly periods (see Figure 4). The minor movement in September was reflected in the slight increase in weight in the last half of that month and in the first two weeks of October. The November influx was accompanied by weight increases in the last part of that month and in early December. The January peak similarly coincided with increases in weight in the last part of the month and in early February, while the weight increase in the second half of March came just before the spring exodus, which usually took place about that time and in the first part of April.

Wolfson (*in litt.*) expressed the opinion that in an altogether sedentary species the weight variations would be negligible, *i.e.*, the difference between the low weight in the fall and the highest before spring would be small. In the regularly migrating White-throated Sparrow this difference is about 15 per cent (Wolfson, 1954:424).

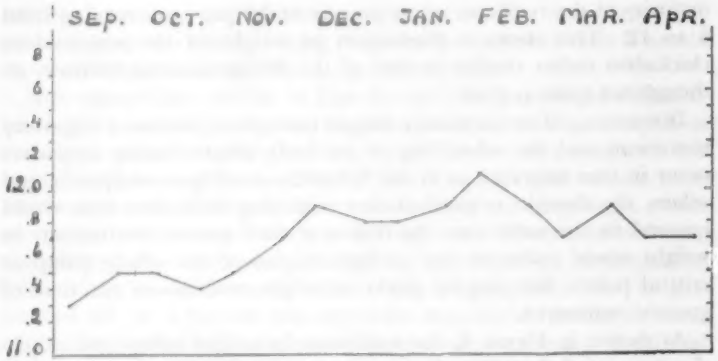

FIGURE 4. The average weights of the chickadees 1948-1954, calculated in half-monthly periods.

This contention led me to analyse the weights of 45 chickadees, 28 of which were residents and 17 non-residents. These birds had been weighed no less than 7 times each throughout one or several seasons and their status was determined by marking and retakes.

The difference between the lowest and highest weights of these birds was calculated in per cent of the low weight and the result is shown in Figure 5. In the non-resident group this difference was over one-third greater than in that of the residents, or an average of 11.1 per cent, ranging from 8 to 17, while it was less than 8 per cent in the

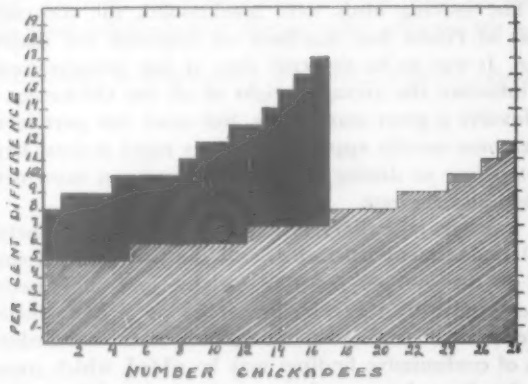

FIGURE 5. The difference between the highest and the lowest weights of 17 transient (solid black) and 28 resident (diagonal hatching) chickadees calculated in per cent for each bird.

majority of the residents, or an average of 7.3 per cent, ranging from 5 to 12. This shows a fluctuation in weight of the non-resident chickadees rather similar to that of the White-throated Sparrow, although not quite as great.

Discussion.—If an increase in weight immediately before a migratory movement and the rebuilding of the body weight during stop-overs occur in true migrants, as in the White-throated Sparrow, Junco, and others, the thought is justified that migrating chickadees also would respond in the same way. In that case their greater fluctuations in weight would influence the average weights of the whole group at critical points, bringing up peaks in weight at or about the time of greatest movement.

As shown in Figure 4, the variations in weight follow too closely the pattern of the chickadees' movements to be dismissed as purely coincidental. It is to be noted that the weight peaks in October, December, and February, occur *after* each of the first three periods of greatest movement, reflecting a majority of *arriving* chickadees rebuilding their body weight at the source of ample food supply. Undoubtedly, more chickadees arrived than departed from a locality where the concentration was marked during the main period of southward movement, extending approximately from September to January. At any rate, the departing chickadees obviously were not numerous enough to produce a pre-migratory increase in weight so great that it influenced the average of all the chickadees together, including both transients and wintering birds. In March, however, the picture was different. The moving birds were northbound, the concentration of chickadees at Pimisi Bay was bent on dispersal, the majority were *departing*. It was to be expected that, if any premigratory increase were to influence the average weight of all the chickadees, not only must it involve a great many birds, but since this particular physiological response usually appears to be very rapid it must happen, not after, but before or during the period of greatest movement. This, indeed, was also the case.

These two data—the difference in weight fluctuation between resident and non-resident chickadees and the correlation found in the patterns of the average monthly weights and movements of the chickadees—constitute the evidence, as far as it goes, demonstrating the influence of migration on the weights of the chickadees. A few instances of confirmative findings may be added, which come to light later in the discussions on the temperature of the air and the fat deposition. While the effect of migration upon the weight fluctuations appears to be negligible, this of course has a reason. In a mixed popu-

lation of residents and migrants other factors also come into play counteracting this effect, making it far less pronounced than it would be in a group consisting of only regular migrants.

It is strange that neither in Owen's study in England nor in Haftorn's in Norway were any increases found in the average weights of their birds after December. Owen (1954:306) recorded a steady decline from November to March, although his data included records from residents as well as from "immigrants and birds of passage, which groups are likely to reach their peak weights at different times during the winter." Haftorn's birds reached their peak weight in December, followed by a continuous decline until March when the weights levelled off. It is known that migratory movements similar to those of the Black-capped Chickadees in North America occur in the Great and Blue Tits and are particularly pronounced in the Coal Tit, at least in Scandinavia (Svärdson and Durango, 1950:236–239). Possibly more extensive data on the European species might alter the picture in this respect.

The Influence of the Temperature of the Air

Owen (1954:304) considered the air temperature an important variable influencing the weights of his birds. The variation in weight shown by three species of his tits during a week in 1951 and the same week in 1952 he attributed to a difference in temperature of 10.6 degrees Fahrenheit. He pointed out that cold spells result in increased feeding and increased weight, but when food is scarce the weight may fall instead. Haftorn (1951:90) found that the mean weights of the Great Tits were relatively low during mild winters, but when the

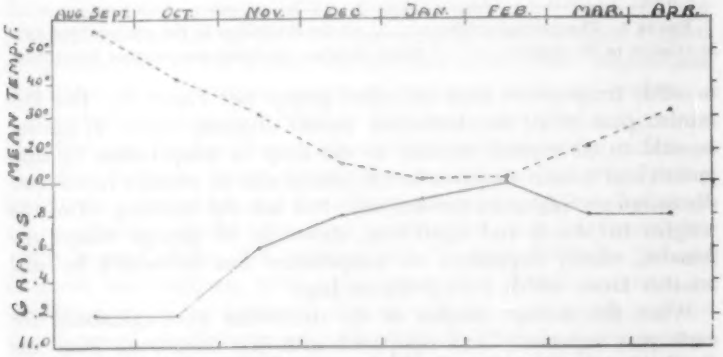

FIGURE 6. The average weights ——— of 66 wintering chickadees in relation to the mean temperature — — — —.

mean temperature decreased the mean weight correspondingly increased.

Baldwin and Kendeigh (1938) conclusively established the inverse correlation between temperature levels and the weights of several species of North American birds.

A test group was selected of 66 chickadees known to have spent the winter uninterruptedly at Pimisi Bay. Their weights (see Figure 6) followed even more closely in inverse order the variations of the mean

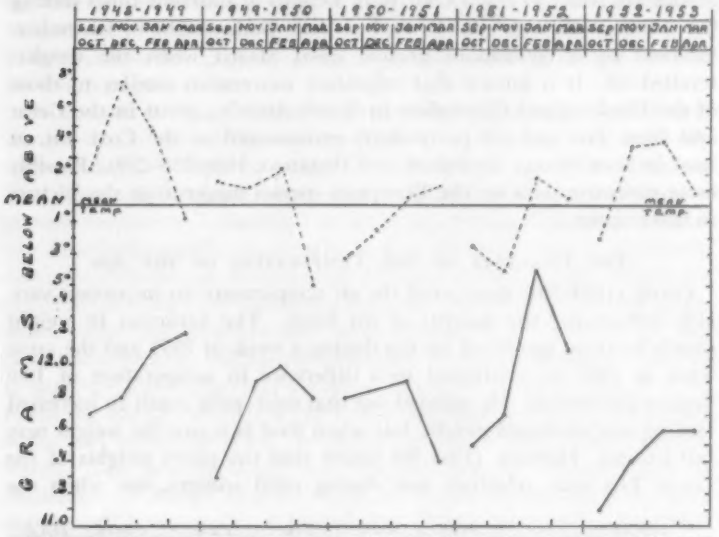

FIGURE 7. The average weights ——— of the chickadees in the winters 1948–1953 in relation to the degrees – – – – above or below the mean temperature Fahrenheit.

monthly temperature than any other group (see Figure 3). The December peak of all the chickadees (center diagram, Figure 3) cannot be said to correspond entirely to the drop in temperature in that month and it must therefore be influenced also by another factor (see discussion on migratory movements). Nor was the levelling off of the weights in March and April-May, shown in all groups except the females, wholly dependent on temperature but influenced by still another factor which I shall discuss later.

When the average weights of the chickadees were calculated for each year separately and compared with the deviations from the normal mean temperature during the same periods the interesting picture of Figure 7 emerged.

First, in the winters 1949–50, 1950–51, and 1952–53, when the weights were 12.0 gms. or lower, the temperatures were not above normal, as would have been expected, but rather the contrary. Only in one year, 1952-53, was the temperature so much above normal that it may, to some degree, have induced the very low weights shown throughout that winter. In the other two winters, 1949–50 and 1950–51, the rather low mean temperature seemingly elicited no response in the chickadees by markedly higher averages of weight. In the fall of 1948 no drop in weight reflected the much above normal temperature of November-December, but the increase in weight in March-April 1949 probably was, at least in part, due to the drop in temperature at that time. The winter of 1951–52 was the critical year when the great migration took place. However, the chickadees did not respond by increases in weight to the unusually cold period in the fall of that year and a food shortage is more likely the factor at work here. Moreover, the unprecedented high peak in January-February certainly cannot be considered in inverse correlation to the above normal temperature, nor does it demonstrate a food shortage and only the factor of migration remains to account for it.

Second, it is to be noted that, irrespective of the vagaries above or below the normal mean of the temperature, all but one winter (1948–49) displayed consistently higher mid-winter levels of weight compared to those of the fall and spring. This pattern of inverse correlation to the mean temperature of the weight curve, corresponding to Baldwin and Kendeigh's (1938:446) principal findings, was shown and followed by the chickadees at Pimisi Bay with remarkable exactitude, when separated into groups or all taken together and apparent even in representative records of the single individual. Thus, by the gradual rise and fall of their average weights the chickadees consistently responded to the gradual fall and rise of the *mean temperature* pertaining to the changing seasons of autumn, winter, and spring.

However, this principal effect of the temperature does not prevent its minor vagaries from being, on occasion, reflected in the variations of weight in birds. Every observer has noticed the increased feeding activity in cold weather, and the influence thereof upon the physiological condition of the bird has been recorded by many workers; Owen (1954) quoted Hicks, 1934, working with Common Starlings (*Sturnus vulgaris*) and Kluijver, 1952, with Great Tits. These variations in weight appear to be connected directly with the food supply and are therefore not wholly temperature-dependent. Thus, as Owen pointed out, if plenty of food is available the birds respond by "overeating" during cold spells, putting on weight and fat reserves; but if an

insufficiency of food does not allow "overeating," which is the bird's immediate response to greater heat loss, it grows thin and loses weight.

Haftorn (1951:90) felt that a possible shortage of food was responsible for the continued decline in weight of his Great Tits after December and that therefore January and February, with the lowest temperature of the winter and food perhaps at a premium, were the critical months. This conclusion, it seems to me, would apply only to a stationary population which, after depleting the available food supply to the limit, could move nowhere to relieve conditions (see also Koskimies, 1955:17–18).

Owen (1954:308) ascribed the early peak and subsequent decline in weight of his titmice to an "adaptive process to provide for possible food shortage later, weight being put on when food is still plentiful." If this had been the case with the Pimisi Bay chickadees, their early accumulated fat reserves, being expended steadily in the course of the winter, would scarcely have sufficed to maintain such a high average weight up to and including March as shown in this study. Obviously, the food supply for the chickadees that wintered at Pimisi Bay, as well as for the transients, with the exception perhaps of the fall months in 1951, was generally speaking adequate throughout the five winters in keeping their subcutaneous fat continuously replenished (see section on fat deposition); and when it was not sufficient they did not remain to starve but moved out.

The Influence of Other Factors

The data show that the weights tended to level off in March, April, and May, at a figure higher than was obtained in the fall months of September and October. The weight for April was 0.1 gm. lower than that for March, while May, taken separately, was 0.5 gm. higher than April.

This levelling off of the weights in spring was also shown in Haftorn's investigation, although his total weight records for the five springs did not exceed 35, and with the difference that it appeared already to begin in February. Baldwin and Kendeigh (1938:434–35) discussed this phenomenon and its causes at some length.

It is logical to think that the incipient breeding cycle would influence the average weights of the chickadees with the growth of the gonads and the levelling off in March and April of the males' weight, as the result of the increasing size of the testes seems evidence of the fact. The females, however, with the full development of the ovaries occurring somewhat later and the exertion of excavating nest cavities, at which they usually work harder than the males, continued to

decline in April but showed a significant increase in May. Kluijver's data (1952) show an increase in weight of the female Great Tits in April, but this slight shift in time is probably due to an earlier beginning of the breeding-season in the milder climate of the Netherlands.

The rise in May of the weight of the Pimisi Bay chickadees (Figure 3) requires an explanation. The data were derived from the records of only 7 birds. Four of these were wintering females, one a wintering male, all residents remaining to breed in the area, and the last two were transients, possibly also females. The male was a particularly heavy bird—his mean weight from 7 weighings during two years was 13.7 gms. Since the time of the day when the weighing took place plays an important role, it is of note that all but one of the seven May weights were recorded after 15.00 hours.

If the two unsexed birds are included as females, four of these showed peak weights in May (three of them in six and one in two weighings), the fifth female declined 0.1 gm. from her March weight, and the sixth lacked comparative data as she was weighed only once. The second week of May, when all the weighings except that of the sixth female were done, is within the egg-laying and start of incubation periods of the chickadees nesting at Pimisi Bay. Hence, even after the effect of the heavy male and the late afternoon weighings is discounted, the influence of 4 to 6 egg-heavy females upon the average weight for May can scarcely be ignored.

The conclusion seems justified that the increase in May and the level of the weights in April were at least partly due to the increased size of the sexual organs in most of the birds, to the presence of eggs in the females, and perhaps also to the fact that some birds at the onset of incubation usually maintain a good weight, only slightly lower than during the egg-laying period (von Haartman, 1954:47; own unpublished data).

The Hourly Fluctuations of the Daily Weights

Several investigators have recorded and discussed the hourly changes in weight in birds. In a Common Redpoll (*Acanthis flammea*) Shaub (1950) found variations in weight up to 15 per cent in a day; Owen (1954) showed that the daily weight rhythm may be related to temperature; Stegeman (1955) found a maximum weight variation of 30 per cent in 24 hours in a migrating White-throated Sparrow in New York State; Nice (1938) recorded daily weight increases in seven species; Baldwin and Kendeigh (1938) concluded that extreme daily weight variations in small birds may vary with differences in the air temperature, amount of feeding, and other activities.

The hourly mean weights of the chickadees are shown in Table 2. These figures are derived from the records of all the chickadees in the five winters. The difference in grams is obtained by subtracting the average of the first five from that of the last five weights of the day in the months August-November when the data were few and the first ten from the last ten in the other five months. The grand difference is the result of the average of the first 50 being subtracted from that of the last 50 weights of the day of the total recorded.

The data for the fall months, August-November, unfortunately were not sufficiently spread over the daylight hours and may not reflect the trends accurately. Such as they are, however, the fluctuations indicate a certain irregularity caused perhaps chiefly by the influence of the temperature. Peak weights at this time came by no means always at the end of the day but often at any moment in the afternoon. The weight pattern in April, when the air grew warmer and conditions approximated those of the fall, strikingly resembled that of August-November, suggesting basically the same causes.

Starting in December, and through February, a change occurred and the hourly weights after an initial drop, usually before 10.00 hours, rose almost without interruption from the forenoon to roosting time, while the difference between early morning and late evening weights increased.

Furthermore, computing the weights of each hour through every month of the winter half-year (for instance, the hour 07.00-08.00 for August through April) produced interesting patterns. The weights in the hours from 07.00 to 11.00 showed the same kind of irregularity as that displayed by the weights of the warmer months, *i.e.*, August-November and April. Thereafter the later the hour of the day the more clearly emerged the same pattern of mid-winter rise in inverse correlation to the mean temperature, as the diagrams of the monthly weights disclose (see Figures 3 and 6).

To check further, the same data were extracted from the 339 records of the 66 wintering chickadees. As would be expected from less quantitative data, these brought out still greater variations and the artificial food supply, always available and plentiful, may have contributed to these wider fluctuations. Nevertheless, they also displayed the comparatively irregular weight pattern of the warmer months and the earlier hours of the day as in the group including the transient chickadees.

The difference between the earliest and the latest weights of the day varied considerably in the two groups. In the group containing all

TABLE 2

THE HOURLY FLUCTUATIONS IN THE AVERAGE DAILY WEIGHTS OF CHICKADEES, 1948–1954

Hour	*Aug. Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April May*	*Mean weight*	*Weighings No*
7-8	—	—	—	—	(12.0)	12.2	11.0	11.7	11.3	16
8-9	—	(12.0)	(12.6)	—	11.5	11.6	11.4	11.4	11.8	34
9-10	10.7	11.4	11.4	(12.3)	10.8	11.2	11.3	12.1	11.3	102
10-11	12.0	11.5	11.5	11.2	11.6	11.6	11.6	11.5	11.6	157
11-12	11.3	11.1	11.3	11.7	11.7	11.6	11.6	11.7	11.6	188
12-13	11.4	11.5	11.7	12.0	11.9	12.1	11.9	12.0	11.9	175
13-14	10.9	11.3	12.1	11.8	12.0	12.2	11.9	11.5	11.9	190
14-15	11.3	11.7	11.4	11.8	11.9	12.0	12.0	11.6	11.8	164
15-16	11.8	11.6	12.0	12.1	12.2	12.4	12.1	12.3	12.2	137
16-17	11.3	11.4	11.8	12.2	12.5	12.2	12.4	11.6	12.1	93
17-18	—	—	—	—	(13.3)	13.1	12.5	12.2	12.4	23
Weighings No	45	46	121	78	254	168	417	150		1279
Diff. in grams	.8	.1	.6	.9	1.6	1.2	2.0	.6	1.1	

NOTE: the figures in brackets denote single weights. For further explanation see text.

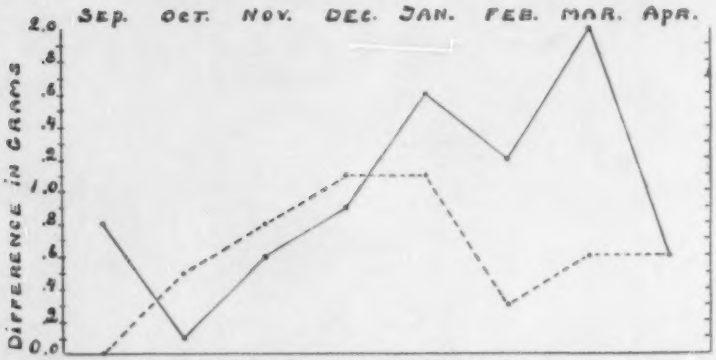

FIGURE 8. The difference in grams of the diurnal variations between the earliest morning and the latest evening weights of all the chickadees ——— and of the 66 winter residents – – – –.

the chickadees, including the transients, it reached almost double the value of that of the wintering chickadees. The last group also lacked the marked peaks in January and March shown by the mixed chickadees, but both groups distinctly displayed the mid-winter rise in this connection as well. The mean difference for the 5 winters was 1.1 gm. or 10 per cent, for the wintering group alone it was 0.7 gm. or 6 per cent.

Discussion.—If great increases in weight occur in many migrating birds during abbreviated periods at certain times, obviously they must also affect the birds' hourly fluctuations in weight at these particular times. Wolfson (1942, 1954a,b) showed how these spectacular increases in weight may occur, and repeatedly pointed out their connection with migration. It is unlikely that even less marked variations in weight of birds belonging to a mixed population of moving and wintering birds, like the chickadees at Pimisi Bay, would not in some manner affect the hourly changes in weight at these special periods. The high peaks in January and March in the difference between the highest and the lowest weights of the day (see Figure 8), which coincided with the major movements of the chickadees in these two months, may well be migration-dependent.

It may be supposed that the food supply of the chickadees was richest in the fall. At this season, spiders were much in evidence and many other insects retiring for the winter into the crevices of twigs and bark became the chickadees' easy prey. The half-opened cones yielded their seeds to the prying bills. Often increased hoarding activity reflected the abundance of food. Judged by the many items one single

chickadee could put away within half an hour, the amount of these hidden stores must have been considerable at times. Later, during the chickadees' minute examination of precisely these spots, remembered or not, most of the hoarded food was retrieved--together with that, no doubt, put away by other birds and the squirrels.

During August-November, the need for generating body heat at a high rate was not great because the mean temperature was relatively high and the replacement of expanded energy after a night's roosting less exigent, so that the rise in the daily weight needed be neither spectacular nor regular. The chickadees' visits to the food sources at this time were not only rarer but also shorter. The birds fed with frequent interruptions of various preoccupations related to dominance and other intraspecific behavior. All this may account for the irregular fluctuations of the hourly weights in these months.

Then, in December, although winter had not yet put its seal upon the land, the rise in weight throughout the day increased and stabilized, under the influence of the diminished daylight hours and the mean temperature approaching the winter low. As winter wore on and the mean temperature reached its lowest level in January and February, the chickadees showed accelerated tension in their behavior. For few minutes during the day the feeding-station was empty, the flocks with marked chickadees returning more often, even at noontime and in the early afternoon, when usually the rhythm of their daily activities slowed down temporarily. The tendency to feed reached its height especially in the forenoon and before roosting time. The great speed they developed in pecking and swallowing, the prolonged time they spent at the food sources, the keener competition or unusual tolerance they displayed toward one another according to circumstances, showed this clearly. The chickadees' urgency to feed was exhibited in the quickening of every move. It was evident, certainly, in the relaxed prudence of the old and experienced chickadees during the all-day trapping sessions when in the late afternoons they finally overcame all fear and entered the traps to feed.

The similarity between this accelerated feeding behavior of the chickadees toward the end of the day and that of regularly migrating species toward the moment of departure is striking. My own observations of the Eastern Chipmunk (*Tamias striatus*) and the Striped Skunk (*Mephitis mephitis*) suggest that a parallel exists in hibernating mammals just before retiring. Hunger, meaning the reaction caused by an empty stomach, does not appear to be the direct or sole releaser, since the time when the behavior is at highest intensity coincides rather with a stomach already filling and with fat reserves already

being well replenished. To this extent Owen's suggestion of anticipatory feeding seems correct.

The mechanism that controls this behavior is not known, nor do we know if the releasers in the various cases are the same. Baldwin and Kendeigh (1938:460) thought that "the primary stimulus for increased feeding may lie somehow in the loss or in the losing of weight itself, a stimulus which is carried over into the following day." In such a case the effect of the stimulus would be delayed and not anticipatory.

The drop in the early morning weights of birds caught about sunrise or slightly later was characteristic of this period. This was apparently due to the energy expended in the initial foraging during the coldest hour in the twenty-four, while the birds' vital reserves were at the lowest ebb after a long winter's night of fasting. In other words, there seemed to be a time when the intake of food did not register because the requirements of caloric energy were temporarily greater than the supply, and it took a certain time and amount of feeding to get these factors readjusted. Furthermore, the intensive early morning feeding common on milder days was omitted, at least until much later, on days when the temperature dropped lower than 20 degrees below zero Fahrenheit. On these frigid mornings the chickadees (as well as the other birds) were conspicuously absent from the feeding-station. Instead they sought sheltered places exposed to the rising sun. Perched on a twig with all feathers fluffed, they sat facing the sun even on days when its rays did not penetrate the clouds. As protection against the north winds they kept behind them rocks, or the rising ground, or the voluminous branches of dense evergreens. On clear days they perched high up in a tree bathing in sunshine. It seemed as if the acquisition of some warmth from this external source of heat was essential before the chickadees could throw all their effort into feeding on these extremely cold mornings. As the sun rose into the sky, they began moving again and the steady acceleration of their feeding activities, imperative for survival, maintained the rise in weight until roosting time.

This delay in the early morning feeding supported Baldwin and Kendeigh's (1938:461) finding that there is a limit to a bird's capacity of adjusting to extremely cold weather. Nevertheless, the endurance of the northern chickadee, thus temporarily past that limit, appeared highly resilient, for no chickadee in good health and with plenty of food available was found dead at this critical hour or at any other time.

The quick tempo of feeding was more marked on cold than on

milder days and it was particularly marked on days preceding a very cold night. Not only was this necessary for keeping up with the increased caloric requirements induced by the cold, but so as to accomplish it, in addition, in a shorter time, because on such days the chickadees emerged later in the mornings and went to roost earlier. Thus the conditioning of the chickadees to a longer fast on colder nights was achieved in advance in a shorter than usual period of time.

It is difficult to see how this reaction could be released by the weight-loss of the previous night (Baldwin and Kendeigh, 1938:460), which could have nothing to do with, for example, a drop in temperature 24 hours later caused by a cold front. Perhaps the stimulus must be sought in the temperature decline itself, in the initial and continued heat-loss within the bird. No doubt wild birds are very sensitive to very slight changes. On many occasions I observed the chickadees go into the fast feeding tempo without any, to me, perceptible indications that the temperature was about to drop below the usual day and night variation, except in the rise of the barometer on my wall and the change of wind direction. Indeed, it may be true that the chickadees can sense also the change of wind and the increasing pressure of the air, even before the temperature starts dropping, without such aids as a weather-vane and an instrument on the wall. However, the internal mechanism regulating these reactions still remains unexplained.

In the marked decline of the difference in morning and evening weights in February, shown by both groups but especially in the wintering chickadees (see Figure 8), additional factors evidently entered into play. A shortage of natural foods may, at this time, have been a contributing agent, although it would be difficult to show a sufficiently great change in conditions from January to February to cause it. Moreover, the trend of the average monthly weights, which showed peaks in February, contradicted the existence of the food factor. Even in the critical winter 1951-52, when a food shortage in the north apparently caused the chickadees' irruptive movements in the south, their weights rose to a high peak in January-February. However, the controlling effect of their migration resulting in an adjustment between the population density and the food supply was in all probability partly responsible for this rise. During February the chickadees began displaying reproductive behavior. Singing, having started in January, became prevalent. Chasing, often in flocks swirling among the trees, gradually grew more frequent and intensive. This disrupted feeding sometimes for long intervals, sufficiently so, perhaps, as to influence the hourly fluctuations but not the major trend of the monthly weights. That the wintering chickadees, of

which many were residents, showed the greater decline bears out this argument.

The Deposition of Subcutaneous Fat

The physiological implications involved in the deposition of fat in birds are beyond the scope of the author. Only data derived from what the observer has seen with her naked eye will be presented for what they are worth.

The monthly variations in the deposition of visible subcutaneous fat in the chickadees are shown in Figure 9. The conclusion presents

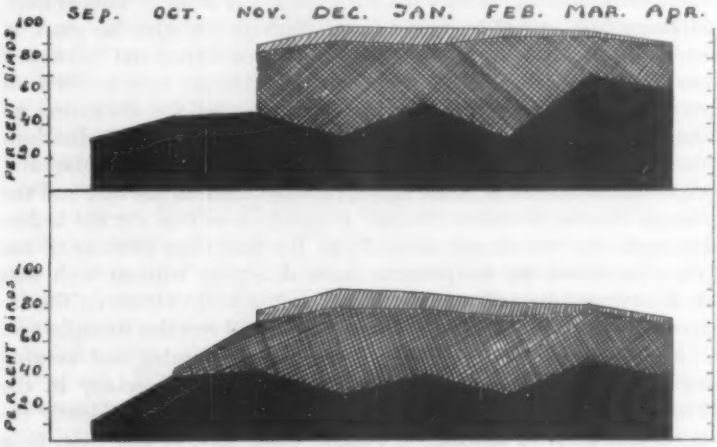

FIGURE 9. Per cent chickadees showing deposition of visible subcutaneous fat. Top—wintering chickadees, bottom—all the chickadees, including the transients. Solid black denotes "little"; cross-hatching, "medium"; diagonal hatching, "heavy."

itself that the accumulation of fat was to an overwhelming degree influenced by the monthly mean temperature.

The peaks in the "little" fat class point of course to a decline in fat at these times and, conversely, the low levels denote an over-all increase as the birds changed from the lower to the higher fat class. The times when these changes occurred coincided precisely with the fluctuations of the monthly weights shown earlier.

However, the similarity between the diagrams representing the accumulation of fat in the two groups of chickadees, with the process underlined in that of the wintering chickadees, indicates a denial of the migration factor and emphasizes the influence of the monthly mean temperature, especially with reference to the highest fat classes. It may be that the showing of the wintering chickadees denotes a

latent "preparedness" for migration revealed in the curve of the "little" fat class, but inhibited for lack of enforcement and transformed, as it were, into the greater values of the high fat classes. Individual records (shown below) attest the influence of the migration factor, at least in March. With the passing into the warmer season, the inhibition of fat deposition happened very gradually and the onset of reproductive activities had less drastic effect upon its disappearance than might have been expected.

These findings also furnish strong evidence that lack of food was never a significant factor, even in the dead of winter. Taken in another sense, the regulating mechanism governing the adjustment of popula-

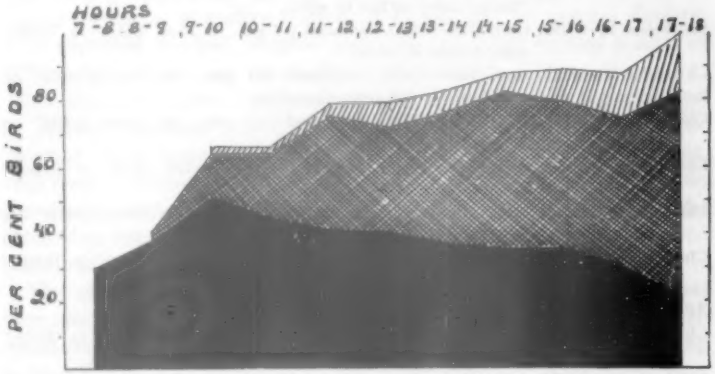

FIGURE 10. The hourly variations of fat deposition in the chickadees. The data include all the birds 1948-1954. Solid black denotes "little"; cross-hatching, "medium"; diagonal hatching, "heavy."

tion density to the food situation was constantly in effective working order. Perhaps the feeding-station was largely responsible for this. Under altogether natural conditions the food situation may play a more incisive role, creating temporary upsets in this important relationship.

As might be expected, the hourly fluctuations in the deposition of fat followed the general outline of the hourly variations in weight (Figure 10). In the individual bird the change from one fat class to another was often spectacular. On some days I could see the fat increasing from hour to hour and puffing out the various regions of the bird's body, its color changing gradually from yellow to creamy white as roosting time approached. A few individual records follow, the data of each bird obtained on the same day.

October records:

Chickadee 22–00246, time 10.10—15.30, increased 0.1 gm., fat class "little," color yellow-white.

Chickadee 22–00253, time 08.50—15.50, decreased 0.1 gm., fat class "none" to "little," color yellow-white.

Chickadee 20–48169, time 09.30—12.45, decreased 0.2 gm., fat class "little," color yellow-white.

March records:

Chickadee 22–00265, time 08.30—14.30, increased 0.5 gm., fat class "little" to "medium," color yellow-white to white.

Chickadee 22–00268, time 09.00—16.10, increased 1.1 gm., fat class "little" to "medium," color white.

Chickadee 22–00259, time 07.30—15.45, increased 1.0 gm., fat class "none" to "little," color yellow to white.

Chickadee 22–00290, time 12.55—13.50, increased 0.4 gm., fat class "none" to "little," color yellow to white.

Chickadee 20–48181, time 10.00—14.45, increased 0.5 gm., fat class "little" to "medium," color yellow to white.

Chickadee 22–00276, time 09.55—17.00, increased 1.3 gm., fat class "little" to "heavy," color white.

Chickadee 20–41878, time 10.20—16.20, increased 1.6 gm., fat class "little" to "heavy," color yellow-white to white.

Chickadee 20–48053, time 09.20—15.20, increased 1.1 gm., fat class "little" to "medium," color yellow to white.

Chickadee 22–00280, time 10.20—15.30, increased 1.0 gm., fat class "none" to "little," color yellow to white.

April records:

Chickadee 20–48189, time 08.40—14.30, increased 0.5 gm., fat class "none" to "little," color yellow-white.

Chickadee 20–48196, time 10.00—17.50, increased 0.4 gm., fat class "none" to "medium," color white.

The October records showed only small and irregular variations conforming to the character of the month (mild autumn weather) and no major movements of the chickadees (compare the monthly and hourly weight variations).

March featured the spring exodus to the breeding-grounds and the fluctuations accordingly were much greater. Of the 25 chickadees yielding adequate morning and afternoon records, 9 of which are given, 3 were residents and 22 transients. One resident showed no change, the second increased 0.3 gm. in weight and the third 0.5 gm., with correspondingly small changes in fat. One transient registered no change in weight but an increase in fat and the remainder increased from 0.3 to 1.6 gm., averaging 0.8 gm., with correlated changes in fat deposition.

The two April chickadees increased 0.5 and 0.4 gm. and the last one,

a transient, increased its fat from "none" to "medium"-plus in the course of seven hours.

Although these individual records point to the influence of the migration factor, nevertheless the principal agent acting upon the deposition of fat in the chickadees at Pimisi Bay was the same as the one which most consistently regulated the monthly and hourly weight variations, namely the gradual rise and fall of the mean temperature of the air.

SUMMARY

From the fall of 1948 to the spring of 1954, during the winter half-year August-September through May, 340 Black-capped Chickadees concentrating at a feeding-station at Pimisi Bay in central Ontario were captured, marked, weighed and released. They yielded a total of 1279 weight records, on which this study is based.

Of these chickadees, 113 were considered males, 154 females, and 73 of undetermined sex. Sexing was based on wing-length, on the "hissing" note sometimes emitted by the females, and on behavior. One female yielded 19 weight records in 5 years and another 5, before she disappeared at the age of 9 years. Thirty-two per cent of the chickadees banded from 1942 to 1954 returned, but none was recovered elsewhere.

The majority of the chickadees were migratory in the sense that they came from other places at various distances from Pimisi Bay, some remaining for the winter, others passing on after stop-overs varying in length.

The number of chickadees captured and retaken from year to year was comparatively stable, except in the winter 1951-52. In that year a sharp drop in numbers occurred, involving especially the wintering birds. This coincided with a mass incursion of the Black-capped Chickadees observed in the southern and eastern parts of Ontario, southeastern Quebec, and into the northern states. Two unusually cold and cloudy summers preceded this event, apparently causing an acute food shortage in the northern ranges of the chickadees.

The aggregation of chickadees in the Pimisi Bay area showed four peaks in September, November, January, and March, of which the last three were of major proportions.

The factor most consistently influencing the variations in weight and fat deposition in the chickadees was the seasonal rise and fall of the mean temperature of the air. The influence of temporary cold or warm spells was much less consistent and often counteracted by other factors, such as migration, reproduction, and the food supply. The

accumulation of fat in the greatest number of chickadees occurred in December and their highest weights were recorded in February.

Increases in weight and fat were brought about chiefly by accelerated feeding. Feeding was markedly intensified during the colder seasons and on colder days. Two peaks occurred in the feeding activities during the day, one in the morning or forenoon which halted the weight loss incurred during the night and the other in the late afternoon when maximum weight and accumulation of fat were achieved before roosting time. When the early morning temperature dropped far below zero (Fahrenheit), the chickadees temporarily lost their ability to adjust to the energy drain of the excessively cold weather by an adequate feeding response, but this condition of maladjustment was never known to become so critical as to cause death, except in the case of sick or otherwise impaired birds.

The intimate interplay between the different factors influencing the changes in weight and fat of the chickadees is shown in this study. Any factor, even the most important, seldom maintained its modifying influence undisturbed for any length of time before another began exercising its counteracting pressure.

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SOME EFFECTS OF X-IRRADIATION ON THE BREEDING BIOLOGY OF EASTERN BLUEBIRDS

BY ROBERT A. NORRIS

THE object of this study, which was conducted in the spring and summer of 1956, was to investigate certain aspects of the breeding biology of Eastern Bluebirds (*Sialia sialis*), with emphasis on effects of relatively heavy, but sublethal, whole-body X-irradiation on adult females, nestlings, and eggs. An underlying assumption was that marked departure from normal breeding behavior and/or normal production of viable eggs and healthy young would provide a rough index of the effects of radiation treatment on the nervous system, sex organs, and other parts of the body. Wild birds are deemed favorable material for the study of radiation effects in nature for several reasons: (1) Their breeding behavior involves a series of rather stereotyped behavior patterns, which tend to follow one another in a sort of chain reaction (one event releasing the next); (2) these patterns and their biological consequences, such as components of reproductive success, are well known in some species (including the bluebird) and hence abnormal behavior can readily be detected; and (3) by utilizing common species which will nest in artificial nest-boxes, one can easily capture individuals for treatment, observe breeding behavior, and follow the fates of eggs and nestlings. An advantage similar to that last mentioned was realized by Blair (1958) who, in a several-year, pioneer study of the ecology of a natural population of wild mice, subjected the adult males to heavy X-irradiation and determined the effects on litter size and other population characteristics.

PROCEDURE

General.—The population of bluebirds under study bred in nest-boxes placed on posts along roads in the Savannah River Plant (SRP) area, Aiken and Barnwell counties, South Carolina. As this species is two- to three-brooded, nesting activity began in late March and lasted through August. Study of the history of each nest required almost daily surveillance. About 70 trips or "rounds" were made to the boxes, which numbered 31, and many additional checks were made on particular boxes or families of birds. There were also limited observations of the Great Crested Flycatcher (*Myiarchus crinitus*) and Tufted Titmouse (*Parus bicolor*), which used four of the boxes in parts of the 1956 breeding season.

For the irradiation of birds and eggs, a Westinghouse "Quadrocondex" machine (228 kvp; 15 milliamperes; with unfiltered X rays)

was employed. It was so adjusted as to deliver, in a horizontal beam, a relatively high dosage rate of 200 roentgens (r) in 8½ minutes (23.5 r per minute) at a target-field distance of 4 feet. This rate is deemed relatively high in view of Stearner's work with young chicks; for interpretations of high and low dosage rates, see Stearner (1949*a*, *b*), and quotations below (pp. 452–3). A Victoreen ionization chamber of 250-r capacity was used as a guide to dosages. A given delivery (say, 400 r) was usually accurate, as determined by the chamber reading, to within 3 or 4 r. Each 200-r exposure was continuous. Each 400-r exposure was fractionated into two 8½-minute periods separated by a 5-minute "rest interval," and each 600-r exposure was given in three 8½-minute periods separated by two such intervals. During an exposure a bird was kept in a resting state in a small container made of ½-inch mesh hardware cloth (with an additional cloth cover). It was believed that this large-mesh cage caused relatively little scatter of rays or, at any rate, modified only slightly the total amount of ionizing radiation intended for the bird. The several eggs exposed to radiation were wrapped in cotton and secured near the top of the cage, so that there was presumably even less scatter in rays that passed or penetrated these smaller targets.

Adult and young bluebirds could be identified as individuals by colored bands which were placed on their tarsi in different combinations. Eggs were numbered or otherwise marked with indelible pencils. Tiny nestlings were marked, where necessary, with colored threads tied rather loosely round their legs or with dye applied to their fluffy natal down.

Résumé of treatment of adult females.—Several of the non-irradiated bluebirds were "strict controls," being caught and taken to the laboratory but receiving no radiation. Most of them were "loose controls," being disturbed only where necessary for purposes of banding, examining nests, etc. Only one of the controls deserted her nest because of my activity. This bird was 6F, a strict control which was caught and handled after laying her third egg; she promptly disappeared without warming her apparently incomplete set or attempting to complete it.

Among the eight females that were irradiated, 5F, which received 600 r, was bringing in nest materials at the time of treatment. The disturbance caused her to abandon her nest. She disappeared within a few minutes and was not seen again. Among the seven females which received X-ray and laid eggs, 10F was given 600 r after she had laid two eggs; she laid three more but deserted soon after completing her set. Fortunately I was able to forestall other desertions by waiting until incubation was well under way before capturing females for

treatment. As an extra precaution, I returned each female to her nest cavity, holding my hand over the entrance for a minute or more before withdrawing. In this way I made certain that each bird saw once again the interior of her nest chamber, whose contents had not been disturbed.

Of the remaining six birds, two, 25F and 26F, received 200 r each; 30F received 400 r; and 4F, 17F, and 28F each received 600 r. Each was taken to the laboratory only once. The mean dosage delivered to these birds together with 10F (all of which are involved in tables 1 and 2) was approximately 460 r.

ACKNOWLEDGMENTS

I am indebted to Marvin Dennis, Joe Halford, C. M. Patterson, and Charles Wright of the du Pont Company and to Goff H. Giboney and Karl E. Herde of the Atomic Energy Commission for their technical and administrative aid. It was through their efforts that routine usage of the X-ray unit (for calibration purposes) was rescheduled so that birds could be irradiated. Both Mr. Herde and Eugene P. Odum, in charge of the University of Georgia Ecological Studies in the SRP area, read the manuscript and provided helpful criticism. Dr. Odum also supplied ready-cut parts of nest-boxes, sawed by J. B. Gentry, which service enabled me to complete the boxes and place them strategically before the nesting season began. The study was carried out under Contract No. AT (07-2)-10 with the Division of Biology and Medicine, U. S. Atomic Energy Commission. In 1957 comparable studies of bluebirds, with emphasis on effects of whole-body irradiation of nestlings, were commenced by William K. Willard, working under the same contract.

RESULTS

Size of egg sets.—The bluebirds in the SRP population laid from 3 to 5 eggs. The eggs in a set were laid one a day, about 8:30 or 9 a.m. Ten sets produced by females in the irradiated group averaged 4.4 eggs; 16 sets laid by non-irradiated birds in a comparable seasonal period averaged 4.1 eggs. Among the non-irradiated birds there was the barest suggestion that smaller sets were laid in later parts of the breeding season. In some populations there is a strong tendency for bluebirds to produce smaller sets as the season advances (Laskey, 1940; Thomas, 1946). In the irradiated females for which two or three broods were recorded, the number of eggs per set was the same in first and subsequent nestings. Thus, 4F (irradiated April 16) completed laying sets of 4 on April 9 and June 9; 25F (irradiated April 20) completed sets of 5 on April 8, June 3, and July 16; and 30F (irradiated

April 25) completed sets of 5 on April 20 and June 12. These data, together with the lack of definitive evidence of reduced hatchability of eggs laid after irradiation of females, indicate that there is no reduction in the effective size of broods following radiation treatment of female parents. These results, preliminary though they are, stand in contrast to those obtained by Russell (1954:831), who states that "acute X-ray exposure of female mice with a dose of 150 r, or perhaps lower, results in permanent sterility. One, and occasionally two, litters can be obtained, even at much higher doses, before the sterility sets in. . . . The litter size in this temporary fertile period is reduced. . . ." Whether the female bluebirds eventually become sterile or less viable is an unanswered question; certainly there is no indication of diminished size of egg sets in the post-irradiation "fertile period."

In an extensive study of a natural population of deer-mice (*Peromyscus maniculatus*) in Texas, Blair (1958), through acute X-irradiation of sexually mature males, induced a significant reduction in litter size which was attributed to radiation-caused lethal mutations. It would be of interest to determine whether such irradiation of male bluebirds (in association with untreated females) would affect size of broods, viability of offspring, or overall productivity.

Incubation period.—As in other birds—for example, the European representative of the Winter Wren, *Troglodytes troglodytes* (Armstrong, 1955)—in bluebirds there is some evidence of longer incubation periods in April and May and shorter ones in June and July. Table 1 indicates that this trend was apparent whether or not the female, which, in this species as in most songbirds, is the only parent that regularly incubates, was subjected to X-ray treatment. Among the various factors affecting length of incubation, the conditions in the nest, including the amount and temporal distribution of body heat applied to the eggs, are of no little importance. Consequently, if the incubating behavior of the female were changed significantly by the onset of radiation sickness, this change might well be reflected by a change in the length of the incubation period. Although the incubation periods of the non-irradiated females averaged slightly shorter than those of the irradiated birds, the differences shown in table 1 are not significant statistically (as determined by *t*-tests). The fact that the incubation period in bluebirds of the SRP area tends to average about 14 days is consonant with the findings of Laskey (1940) at Nashville, Tennessee, who found it to last 13 to 14 days, and of Thomas (1946) at North Little Rock, Arkansas, who found it to extend from 13 to 15 days, centering around 14. Like Smith (1937),

I had one instance of a 16-day incubation period; this was a fairly early nest, wherein the set was completed on April 28.

TABLE 1

INCUBATION PERIOD IN RELATION TO SEASONAL CHANGE AND TREATMENT OF FEMALES

	Incubation Period Ending				*Total Records*	
	Apr. 25 to May 31		*June 1 to July 31*			
Treatment	*No.*	*Period in Days*	*No.*	*Period in Days*	*No.*	*Period in Days*
Irradiated*	4	14.9	3	13.8	7	14.4†
Not irradiated	5	14.3	9	13.7	14	13.9

* In most instances birds were irradiated early in the incubation period.

† Differences between incubation periods of irradiated and non-irradiated birds are not significant (P-values greater than .10).

An unusually long incubation period of 18 days (±1 day) was recorded at the first nest of 11F, an untreated bird whose first egg was irradiated and transferred to 7F's nest. It was because 11F failed to lay the next day after the first egg was irradiated that I transferred this egg; at the time I thought that she had deserted. But on the following days, April 30 and May 1, she proceeded to lay two more eggs. The protracted incubation period could have been due to 11F's laxity in the task of incubating, possibly because of the abnormally small set of two eggs. Or it could have been due to relative inviability of the young, both of which died shortly after hatching. The latter possibility is supported somewhat by the fact that 11F's second set, of which the fourth egg was laid June 11, failed to hatch. In all four eggs the embryos had died when about half developed. With this larger set, incubation was normal as attested by the parents' solicitude, as well as definite warmth of the eggs, for fully 16 days after the last had been laid.

Hatching success.—As brought out in table 2, there was a relatively small difference in hatching success of eggs under non-irradiated females as compared with irradiated ones. If two of the aforementioned birds, the control 6F and the irradiated 10F, are omitted from consideration (since they were all but "forced" to desert), then the difference between hatching-success values of non-irradiated and irradiated samples in a seasonally comparable period is so slight as to be non-significant if not negligible. These data would seem to provide further evidence that conditions in the nest, including the roles

of the incubating females, were well nigh the same for treated and untreated birds.

Laskey (1952) has pointed out that the bluebird's hatching success is higher early in the breeding season and lower in the later, warmer part of the season. This trend is well exemplified by the data on hatching success of eggs of non-irradiated females (table 2), which ranged from about 86 per cent in spring and early summer (seasonal periods 1 and 2) to a lower, cumulative value of 70–71 per cent for the entire season. Such a trend is not evidenced in the irradiated

TABLE 2

HATCHING SUCCESS OF EGGS IN RELATION TO SEASONAL CHANGE AND TREATMENT OF FEMALES

	Cumulative Data on Hatching Success					
	Eggs Incubated by Non-Irradiated Females			*Eggs Incubated by Irradiated Females**		
Seasonal Period	*No. Laid*	*No. Hatched*	*Per Cent Hatched*	*No. Laid*	*No. Hatched*	*Per Cent Hatched*
(1) April 7—May 31	30 (7) †	30	100	30 (7)	22	73.4
(2) June 1—16	51 (12)	44	86.3‡	44 (10)	34	77.3
(3) June 17—30	64 (15)	53	82.8	(none)	(none)	—
(4) July 1—16	88 (22)	63	70.5	49 (11)	39	79.6‡
(5) July 17—30	96 (25)	68	70.8	(none)	(none)	—

* Birds were irradiated in seasonal period 1 when incubation of completed sets (with one exception) was under way; for irradiated females, data from periods 2 and 4 pertain to second broods of three individuals (at which time "delayed radiation effects" might have been operative).

† Number of egg sets in cumulative arrangement are given in parentheses (these totaling 25 for non-irradiated birds, 11 for irradiated ones).

‡ On the basis of seasonal spread of laying, the cumulative hatching-success value, 86.3 per cent, should be compared with the value 79.6 per cent, as this subsample from the non-irradiated birds is seasonally comparable to the total sample from the irradiated birds (mean dates of completion of sets being May 18 and May 19, respectively).

birds, probably because here the sample is smaller and pertains chiefly to relatively early broods. Whereas in the SRP area hatching success of non-irradiated birds throughout the nesting season was about 71 per cent, that recorded in some other regions has been somewhat lower. Thus, Laskey's (*ibid.*) study of the 1952 population of bluebirds at Nashville revealed an overall hatching success of about 62 per cent. This value might have been higher, however, if the summer had not been extremely hot and dry.

Nestling period.—The average nestling period of seven broods of young bluebirds having non-irradiated female parents was 16.7 days (extremes 15.2—18.2); that of four broods having irradiated mothers was 16.4 days (extremes 15.2—17.1). This difference is not significant. There remains a strong indication that brooding and food providing by treated and untreated females is essentially the same. This has been borne out in some measure by observations of activities of females at and near their nests.

Comparable nestling periods of 14 to 17 days, commonly 16, have been reported from Tennessee (Laskey, 1940; Laskey, *in* Bent, 1949:244), and others of 17 and 18 days have been recorded in Arkansas (Thomas, 1946). In Vermont, Smith (1937) found the period spent by the young in the nest was usually 18 days. It seems likely that this period averages a day or two shorter in the southern United States than in the New England region.

General reproductive success.—Among 17 nesting attempts by pairs in which the females were not irradiated, 11 succeeded (in that one or more young were fledged) with a total of 42 young leaving the nests—an average of 2.4 fledglings per parent pair. Of 10 attempts by pairs in which the females were irradiated, 7 succeeded with a total of 30 young leaving the nests—an average of 3.0 fledglings per parent pair. These data are derived from all recorded nesting attempts of irradiated birds and from a majority of the recorded attempts of non-irradiated birds. In order to keep the samples seasonally comparable, some of the latest attempts—in late June and July—by untreated birds are omitted. As a consequence, the mean dates of nesting, specifically the times of laying of the last egg, for the treated and untreated birds here considered are May 13 and May 20, respectively. The establishment of seasonal comparability of samples is necessary, for Laskey (1939), among others, has noted that earlier nests of bluebirds have a higher percentage of success than later ones. It is likely that the above-indicated difference in which more young were fledged from nests of treated females than from those of untreated, is rather misleading and that a larger mass of data would reveal for the compared groups either no significant difference or possibly somewhat lessened reproductive success in the treated group. If any conclusion can be drawn, I believe it is best stated tentatively and negatively: there is no suggestion whatever that pairs in which females were irradiated were less successful in producing fledglings than were other pairs in which the females were not irradiated.

The fact that these quantitative aspects of the species' reproductive potential seemed essentially unchanged by the radiation treatment of

female parents, suggests that one X-ray dosage strong enough to kill half the irradiated birds in, say, a period of 30 days (LD 50/ 30 days) would have to be comparatively high. Among mammals the LD 50 dosage (lethal dosage to 50 per cent) is about 200 r for guinea pigs, 400 to 600 r for different strains of laboratory mice, 700 r for hamsters, and 790 to 800 r for rabbits (Boche and Bishop, 1954; Bloom, 1948). These dosages could be either in one continuous treatment or fractionated. Because the general appearance and demeanor as well as the reproductive activity of the female bluebirds seemed to remain normal in spite of dosages of 200 to 600 r, it would seem that an LD 50 dosage for these birds would be higher than that of the laboratory mammals. One is tempted to conjecture that it might well exceed 1000 r, even with a high dosage rate.

Irradiation of eggs and nestlings.—From table 3 it is apparent that embryos are more vulnerable to X-irradiation than are adult birds. Yet it is of interest that three eggs, including two that were irradiated when incubation was under way, yielded nestlings which developed normally from all gross evidences and left the nest successfully.

TABLE 3

FATE OF IRRADIATED EGGS IN RELATION TO DOSAGE AND PROGRESS OF INCUBATION AT TIME OF EXPOSURE

Eggs Not Hatching			*Eggs Hatching But Nestlings Dying*			*Nestlings Successful in Fledging*	
Dosage (r)	*Progress of Incubation (Days)*	*Egg Contents*	*Dosage (r)*	*Progress of Incubation (Days)*	*Age of Nestling at Death (Days)*	*Dosage (r)*	*Progress of Incubation (Days)*
400	0–1*	6-mm. embryo	200	0–1	9 or 10	200	3–5
600	1–3	full-term embryo	400	0–1	9 or 10	400	8
600	5	full-term embryo†	400	9	3 to 7	600	0–1

* 0–1 refers to freshly laid egg.

† A teratological specimen (the limbs were poorly developed and the toes were mere nubbins).

Comparable data were obtained from two other bird species. Two fresh eggs of the Great Crested Flycatcher were each given 600 r. In one the embryo died when about 7 millimeters long; in the other it died when about full term, although it seemed unusually slender and showed signs of hemorrhage in the belly region. Two eggs of the

Tufted Titmouse, both of which had been incubated 9 or 10 days, were given 600 r and 200 r, respectively. Whereas the former failed to hatch and proved to have a dead embryo, the latter produced a nestling which, along with its four siblings, succeeded in fledging.

Although some of the heavily irradiated eggs resulted in nestlings and fledglings, it does not necessarily follow that all these young were to be vigorous, fertile, and otherwise successful in intra- and interspecific competition.

The oft-stated fact that young animals are more sensitive to radiation damage than older animals is borne out to some extent by the findings of Bloom (1948:751) who reported that "in . . . three-week chicks certain organs were extremely damaged while in older chickens and in the adult mammals they were [relatively] radioresistant." Similar differences, especially in the resistance of kidney tissues, have been reported by Stearner and Christian (1949–50) and by Stearner *et al.* (1955). In the four bluebird nestlings which were irradiated (table 4) there might have been considerable tissue damage, but there was no evidence of sickness in any of these birds. From all gross appearances they withstood the heavy dosages about as well as the adult females. Particularly interesting was the fact that the week-old, pin-feathered nestling given the massive dosage of 1200 r appeared to develop as normally as its siblings and was successful in fledging. At all the nests under observation, the immatures tended to disappear from the nest-box vicinity within a day or two after they left the nest. The post-fledging history of these young was not followed.

In one-week white leghorn chicks, Stearner (1949*a*) found that the LD 50 dosage (at both 4 and 14 days) was between 600 and 800 r where the dosage rate was 43 r per minute, and 900–1000 r where the rate was 6 r per minute. Newly hatched ducklings (mammoth white Pekins) "showed the same reaction to irradiation as was seen in

TABLE 4

IRRADIATION OF BLUEBIRD NESTLINGS

Nest-Box No.	No. in Brood	Designations of Irradiated Individuals	Treatment: Date	Treatment: Age of Nestling (Days)	Treatment: Dosage (r)*	Results
4	5	YY-G	May 10	13	400	Both fledged normally when 17 days old; no loss in weight
		BB-G	May 8 & 10	13 & 15	800	
31	5	B–O	May 29	7 (approx.)	600	Both developed normally, fledging 9 days after treatment
		O–R	May 28 & 29	7 (approx.)	1200	

* BB-G received 400 r each day; O–R, 600 r each day.

chicks. . . ." (*ibid.*). As pointed out in a subsequent report (Stearner, 1949*b*), survival in chicks "following continuous and fractionated dosages at an average rate of 11.5 r per min. resembled that which follows low rate exposures, while survival after continuous or fractionated dosages at an average rate of 18.5 r per min. were characteristic of that seen after exposures at 43 r per min." For these reasons the dosage rate of 23.5 r per minute as applied to bluebirds is interpreted as "high" and as having effects comparable to that of 43 r per minute. Although the data from nestling bluebirds are scanty, they do raise the question whether, at a given age, the altricial young of wild songbirds are somewhat more resistant to ionizing radiation than are the precocial young of laboratory chicks and ducklings.

Notes on irradiated females of other wild birds.—Five pairs of Great Crested Flycatchers attempted to nest in bluebird boxes, but none of the attempts was successful. One female captured at box 13 at 9 a.m., May 25, was exposed to 600 r. Incubation had not yet begun (in fact, the bird laid her fifth egg in the cage while being carried in for treatment), and, perhaps for this reason, this individual deserted her nest soon after I returned her to the nest cavity. She was not seen again. Unfortunately I could not determine the fate of her eggs. Although I transferred them to a bluebird nest, they were punctured within a day or so—apparently by the bluebird, which seemed to reject these too-large, wrong-colored eggs.

Results with another irradiated Great Crested Flycatcher are somewhat more valuable. This female, in box 17, was given 600 r on May 31, one day after she had deposited her fifth and last egg. The incubation behavior that followed seemed relatively normal, for by June 13 three eggs, all non-irradiated, had hatched. Two other irradiated eggs, as mentioned in a preceding paragraph, did not hatch. About the time the three eggs hatched, the female disappeared, apparently deserting. The male did not stay around either, and the nestlings died. The untimely disappearance of this female which, like most of the bluebirds, had received X-ray treatment at the incubation stage, had no parallel among the bluebirds. Conceivably there are biologically significant differences in response to whole-body irradiation by different species of birds. Moreover, it is possible that the Great Crested Flycatcher, which belongs to the suborder Tyranni (tyrant flycatchers and allies), has relatively less resistance to radiation than the bluebird and Tufted Titmouse, which belong to the suborder Passeres (songbirds), following the classification of Wetmore (1951).

Nest-box 1 was used by a pair of Tufted Titmice. When the female was incubating six eggs on May 23, she was captured, color-banded,

and given 600 r. On May 27 the eggs (excepting the above-mentioned, heavily irradiated one) hatched, and two days later both parents were watched as they fed their young. It was clear that both cared for the young throughout the nestling period. When I visited the box on June 8 in order to band the nestlings, both the male and female came fairly close and issued scolding notes. Three days later the young departed from the nest. Like the bluebirds, the female titmouse showed no signs of radiation sickness.

SUMMARY

In 1956 several aspects of the reproductive biology of Eastern Bluebirds were studied in the Savannah River Plant area of South Carolina. The birds bred in nest-boxes throughout the spring and summer. In April and May some of the adult females and nestlings were exposed to X-irradiation, color-banded, and returned to their nests. The dosage rate was high, 23.5 r per minute, and most of the individuals received from 200 to 600 r. Several eggs were also exposed. The breeding biology of irradiated and non-irradiated females was essentially the same in the following respects: size of sets of eggs, length of incubation, hatchability of eggs, nestling period, and general reproductive success. In both irradiated birds and controls there were records of second and third broods. Developing embryos were rather vulnerable to radiation. Among nine irradiated bluebird eggs (mean dosage about 420 r) the embryos died in three instances and the nestlings produced died in three instances; the nestlings hatching from the other three eggs succeeded in fledging. Four nestlings given 400 to 1200 r developed normally and fledged successfully. It is suspected that week-old songbirds might have greater radioresistance than laboratory chicks and ducklings of the same age. Limited data obtained from other box-nesting species, the Great Crested Flycatcher and Tufted Titmouse, suggested that the titmouse, at least, was similar to the bluebird in its resistance to radiation sickness.

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THE GLOSS OF EGGS

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IT HAS been a matter of occasional comment from the earliest times that some species of birds lay very glossy eggs while others lay very dull or matt ones. It has no doubt been observed that within the same species, one female will sometimes lay much glossier eggs than another. Presumably it may have been noted that sometimes within a single clutch some eggs will be glossier than others, for at times it is very obvious, but we have seen no comments on the point. Much more often the difference may escape casual notice, but can be seen if it is deliberately looked for. In other cases it seems impossible to say that any difference exists with the unaided eye, and objective instrumental tests become necessary. It seemed to us that the phenomenon was very widespread among many species, and, by considering the egg shapes and pigmentation, it appeared probable that it was the last egg that was normally the least glossy. The present investigation tests these points by means of a gloss-meter devised for this purpose.

METHODS

The following sets of eggs became available:

Great Skua or Bonxie (*Catharacta skua*). Through the kindness and collaboration of Dr. Finnur Gudmundsson, nine clutches each of two eggs, of the nominate race from southeast Iceland, collected at one time in 1954, were obtained.

Black Guillemot (*Cepphus grylle*). Through the kindness of Professor Charles E. Huntington, ten clutches were obtained from Kent Island, Maine in 1955 and 1956. Since they were not obtained simultaneously, there is a possibility of duplication of parentage, but the eggs of 1955 and those of 1956 show much the same significant differences when tested separately.

House Wren (*Troglodytes aedon*). Fifteen clutches obtained on the Preston Laboratory grounds (Butler, Pennsylvania) in 1956 were tested. It is practically certain that some parentages were duplicated, but in 1957 a much longer series, more than forty clutches, was obtained, and it was clear that the phenomena were persistent ones and that duplication of parentage was not too serious a disturbing factor.

American Robin (*Turdus migratorius*). Thirteen clutches were available, collected on the Preston Laboratory grounds, mostly in 1957. There was probably little or no duplication of parentage here, and the decline of gloss on the last egg was quite pronounced in most clutches.

Laughing Gull (*Larus atricilla*) and Common Tern (*Sterna hirundo*). These collections of eggs from New Jersey served for previous reports on egg shape and egg pigmentation (Preston and Preston, 1953; Gemperle and Preston, 1955; Preston, 1957). In the present investigation we used 16 clutches of the Laughing Gull and 22 of the Common Tern.

Common Starling (*Sturnus vulgaris*). Thirteen clutches of these eggs were collected on the Preston Laboratory grounds in 1957. Here it is certain that there was much duplication of parentage due to renesting, and the series was not very satisfactory on that account. The measurements show a substantial difference in gloss due to parentage, that is, from clutch to clutch, but no certain difference due to sequence. This finding should not be assumed to apply to the species in its entirety on the basis of this sample, but the results are included since they may indicate that there are species that do not follow the general rule of decreasing gloss.

Assorted Eggs

With the point proved for several species, it becomes possible to take a short cut as to how "birds in general" behave. By taking a random sample of clutches of many species, it is possible to establish that most species act in a particular way, though it is *not* possible to say that any specified species does so, since the number of clutches of any *single* species was statistically inadequate. We had available eighteen clutches of fourteen species, all but three collected at Preston Frith (the Preston Laboratory Grounds), mostly in 1956 and 1957. These may fairly be regarded as a random sample of the commoner birds of western Pennsylvania, or indeed of a much more extensive area of the northeastern United States.

The series (one clutch of each species, unless otherwise stated) is as follows: Least Tern (*Sterna albifrons*), Mourning Dove (*Zenaidura macroura*), Yellow-shafted Flicker (*Colaptes auratus*), Great Crested Flycatcher (*Myiarchus crinitus*), Eastern Phoebe (*Sayornis phoebe*) (two clutches), Tree Swallow (*Iridoprocne bicolor*), Tufted Titmouse (*Parus bicolor*), Catbird (*Dumetella carolinensis*) (two clutches), Brown Thrasher (*Toxostoma rufum*) (two clutches), Eastern Bluebird (*Sialia sialis*), American Redstart (*Setophaga ruticilla*), House Sparrow (*Passer domesticus*), Rufous-sided Towhee (*Pipilo erythrophthalmus*) (two clutches), and Song Sparrow (*Melospiza melodia*).

The selection, from the material available with known sequence of laying, is random, except that species covered more completely in the other series are omitted. Note that most are passerines, though three

are not, and that all were obtained in western Pennsylvania except the Least Tern and Tree Swallow (southern New Jersey).

With the smaller eggs we measured the gloss at four points around the egg; with the larger eggs this was increased to six. The variations in readings thus obtained, usually small, are ascribed to the "Test." They might represent real variations in gloss from place to place on the egg, or might be due to our placing the egg slightly differently over the testing aperture.

In the case of the Laughing Gull and Common Tern we used only clutches that consisted of three eggs, and we measured all the eggs. Then by an Analysis of Variance we first proved a significant difference between first and terminal ('F' and 'T') eggs, and then proved further that a smaller, but still significant, difference existed between first and second ('F' and 'S') eggs. With all other species we measured only first and terminal eggs, though with the Skua and some others the second egg was also the terminal one.

TABLE 1

"G" VALUES FOR FIRST AND TERMINAL EGGS OF VARIOUS SERIES

	Mean "F"	*Mean "T"*	*Difference*	*% Diff. Mean F*	*No. of Clutches Tested*
Great Skua	2.07	1.89	0.18	8.7	9
Laughing Gull	3.06	2.85	0.21	6.9	14
Common Tern	2.50	2.32	0.18	7.2	22
Black Guillemot	2.46	2.33	0.13	5.3	10
House Wren	1.88	1.78	0.10	5.3	15
Robin	3.20	2.94	0.26	8.1	13
Starling	3.29	3.27	0.02	0.6	13
"Assorted Eggs"	2.76	2.61	0.15	5.4	18

"G" VALUES FOR FIRST AND SECOND EGGS OF VARIOUS SERIES

	Mean "F"	*Mean "S"*	*Difference*	*% Diff. Mean F*	*No. of Clutches Tested*
Laughing Gull	3.06	2.98	0.08	2.6	14
Common Tern	2.50	2.42	0.08	3.2	22

In all cases except that of the Starling the difference reported is significant to the 1% level.

Procedure and Apparatus

When light is incident on a perfectly glossy surface, its reflection can only be observed at the specular angle, equal to the angle of incidence. A perfectly matt surface, on the other hand, is one with uni-

form microscopic irregularities and it reflects, or diffuses, the light equally in all directions. Most surfaces combine the properties of the matt and glossy surfaces. The incident light, besides being reflected at the surface, may also penetrate beneath the surface to be absorbed, transmitted, or internally reflected. In the case of egg shells, moreover, instead of uniform plane surfaces we must deal with curved, pigmented surfaces, further complicating the picture.

Since light which is reflected from a surface, then, is composed of a diffuse component reflected in all directions and a glossy component, reflected in the specular direction, we decided to measure the gloss by means of a gloss number, G, defined as

$$G = I_1/I_2$$

where I_1 is the measured intensity in the direction of specular reflection and I_2 is the intensity in the direction of the normal measured at the same distance from the point of incidence on the shell. The angle of incidence used was 45°.

While it is not certain that these measurements will correlate perfectly with visual gloss estimates, they seem to come close to doing so and the method adopted measures a property of the egg which is closely allied with its "gloss," and a systematic tendency of this property to vary with the clutch sequence is indicated.

The measurement of the specular and normal light intensities was done with a light balancing circuit using two photo-electric cells. The size of the aperture through which light reached one of the cells was varied until both cells received the same amount of light. The ratio of intensities was then found from the inverse of the ratio of sizes of the apertures. More details on the optical arrangement and the electrical circuit may be found in the complete report of these tests being filed at Carnegie Museum, Pittsburgh.

The procedure followed was to position the egg carefully against a small aperture where a small beam of light was incident on the shell at an angle of 45° to the plane of the aperture. The specularly reflected beam, somewhat defocussed by the texture and curvature of the shell, was then centered on the aperture to one of the photo cells. The other cell was placed so as to receive the light diffusely reflected in a direction perpendicular to the plane of the aperture. The aperture to the first cell was then adjusted for balance.

An effort was made to select a portion of the egg as free as possible from dark spots, that is, a region of uniform background color. But it is not the nature of eggs to be perfectly uniform in this respect and no doubt some tiny spots of pigment were often included. Further-

more, the so-called background colors of the eggs to be compared, that is, of the two or three eggs of the same clutch, were not necessarily identical. It must be emphasized, then, that a single measurement is a function only of the spot on which it was made and is not necessarily characteristic of the whole egg. However, by measuring several places around the egg, we put ourselves in a position, by means of a partition of variance, to see if this matter is important.

The tabulations of the actual measurements are voluminous and tedious; they also are being filed at Carnegie Museum. The data were submitted to a three-way analysis of variance to determine (a) whether gloss varied significantly from spot to spot around the egg, (b) whether it varied significantly between the various eggs of a clutch and especially between the first and last eggs of a clutch, and (c) whether it varied with the parent. The interactions between these factors must also be considered. This is standard practice, but is once more a lengthy and tedious business. The details are being filed at Carnegie Museum, where they may be consulted by those interested.

When the variance ratio is less than that for the 5 per cent level we have considered that we have failed to prove significance: if it exceeds the 1 per cent level we have considered it definitely significant: in between is a zone where we might suspect significance but conviction could come only from much more testing.

DISCUSSION

It appears that, in general, eggs are about equally glossy all the way round, which in a sense is evidence that the apparatus is satisfactory as well as the egg. Except in the case of the Starling, there is substantial (significant) difference between the gloss of eggs from one parent and those from another, and there is also substantial difference between the gloss of the first and last eggs of a clutch, the first tending to be definitely more glossy, though there are occasional exceptions. Further, the interaction component shows that some parents lay eggs that, independently of the actual level of gloss in the clutch as a whole, decline more spectacularly in gloss from first to last egg than do the eggs from other parents.

In some cases the decline in gloss appears to be concentrated on the last egg. For instance in the Flicker clutch, all the eggs but the last were very glossy, while the last egg was very matt, as if the bird had suddenly run out of mucin (Romanoff, 1949:170), or whatever it is that makes eggs glossy. But in many other cases the decline is clearly spread over the whole sequence, though generally accelerated at the last egg. This can often be detected without instruments. As men-

tioned above we have investigated the matter instrumentally for two species only, the Laughing Gull and the Common Tern and shown that there is a statistically significant difference between first and second eggs (a matter we were not sure about in these species by mere visual inspection), but the major decline is between the second and third (or terminal) eggs. In this respect gloss follows the general pattern of pigmentation and shape—the major change comes with the last egg.

In the collection of "Assorted Eggs," in most cases the last egg was distinctly less glossy than the first. In any species, the extent to which the first egg is glossier than the last varies considerably: it may be a big difference, or it may be a slight one, but it is almost always in the same direction. The reverse arrangement, with the last egg *more* glossy, has been encountered several times, but then the difference is usually slight, so that there is virtual equality of gloss between first and last eggs. These exceptions are: (1) Mourning Dove (one clutch); the difference is slight. However there is some possibility that doves and pigeons rather generally lay eggs that do not differ appreciably in gloss. (2) Song Sparrow (one clutch); this may have been a freak instance. (3) Eastern Phoebe (two clutches); in one clutch there was no difference; in the other, the last egg was somewhat more glossy. This species is peculiar in that the last egg of a clutch seems to carry more pigment, the wreath of cinnamon spots at the large end being more pronounced on the last egg. (4) American Redstart (one clutch); the first and last eggs are almost identical in gloss. (5) Brown Thrasher (two clutches); in one clutch the gloss declined a great deal from first to last egg; in the other clutch there is a very trifling *increase* in gloss, the two eggs being almost identical. None of these observations has any statistical significance, but a larger series of clutches might uncover species besides the Starling where gloss does not decline regularly with sequence.

While the readings of the gloss meter probably give an accurate comparison between eggs of approximately the same size, so that, for instance, the relative gloss of American Robin and Starling eggs may be compared directly, it is possible that with eggs of radically different size and curvature we cannot make a very direct comparison. The gloss values as reported by the instrument may not be completely independent of the size of eggs. For all we know the human eye may experience the same difficulty, but perhaps we unconsciously make some allowance for it, which the instrument cannot do. We have not investigated any of these matters, having been concerned for the present chiefly to determine variations of gloss within a clutch or a series

of clutches of one species, and we believe the results here are strictly valid.

There are other points that come out in the analysis, but for these the typescript at Carnegie Museum should be consulted.

CONCLUSIONS

(1) Assuming that the available series of clutches are representative of the corresponding species (which seems probable), there is a systematic tendency for the "terminal" egg to be less glossy than the first egg in clutches of the following species: Great Skua, Laughing Gull, Common Tern, Black Guillemot, House Wren, and Robin. The test of "assorted eggs" indicates that this must be true of many other species, though the number of clutches examined of any one species is inadequate to show of which species it is true.

(2) The magnitude of this effect depends to a considerable extent on the parent as well as the species; the degree to which it is consistently independent of the individual parent is highest in the cases of the American Robin and House Wren.

(3) We have found no evidence of any such systematic tendency in available clutches of the Starling.

(4) In the clutches of three eggs which were tested, of the Laughing Gull and Common Tern, the first egg appears to be generally more glossy than the second. It is the third, or final egg, however, which differs most from the others.

(5) All the series tested containing no duplications of parentage show a systematic tendency for the gloss to vary with the parentage.

While "gloss" is a rather complicated concept, something agreeing quite closely with what we experience as gloss can be measured by purely physical (instrumental) means, and the instrumental readings confirm our subjective findings, though they are more sensitive in detecting small differences, and are quantitative in nature.

With these and previous papers it seems to be established that with many species the following things come to pass as the clutch sequence proceeds:

The eggs gradually become less glossy, usually with a great acceleration at the last egg. (This paper.)

In some species, such as the House Wren, the size of the egg increases as the clutch progresses (Kendeigh *et al.*, 1956); but in others such as the Herring Gull (*Larus argentatus*) and Lesser Black-backed Gull (*Larus fuscus*) (Paludan, 1951, quoted by Andersen, 1957), the Laughing Gull (Preston and Preston, 1953), the Common Tern (Gemperle and Preston, 1955), and the Velvet Scoter (*Melanitta fusca*)

(Koskimies, 1957, good bibliography), the breadth of the egg is significantly less in the last egg of the clutch. The shape changes, the two ends becoming more nearly alike (Preston and Preston, 1953).

The pigmentation declines, especially in the last egg of the clutch, (but the reverse is true of the Phoebe, *Sayornis phoebe*) and becomes differently distributed (Preston, 1957).

In general, if one egg differs substantially in any way from the rest, it is likely to be the last egg of the clutch.

Acknowledgments

We are indebted to Miss Yvonne Walters for a substantial part of the calculations and no small part of the actual gloss measurements, and to Dr. Richard E. Mould for help in the design of the apparatus, which was constructed largely by Mr. George F. Wiest, all members of the Preston Laboratory staff.

SUMMARY

1. Tests of eggs with a specially devised gloss-meter indicate that there is a systematic tendency for the last egg of a clutch to be less glossy than the first egg in the Great Skua, Laughing Gull, Common Tern, Black Guillemot, House Wren, and American Robin. This tendency was not found in the Starling.

2. Tests of one or two clutches of a number of other North American species, while statistically inadequate to show the situation in any one of such species, do suggest that the tendency for the terminal egg to be less glossy prevails generally, though it may not hold for all species or all clutches.

3. There is an apparent tendency for gloss to vary with parentage of the eggs.

4. The tendency for the last egg of the clutch to be less glossy is similar to previous findings that the last egg tends to differ in other respects, such as size, breadth, shape, and pigmentation.

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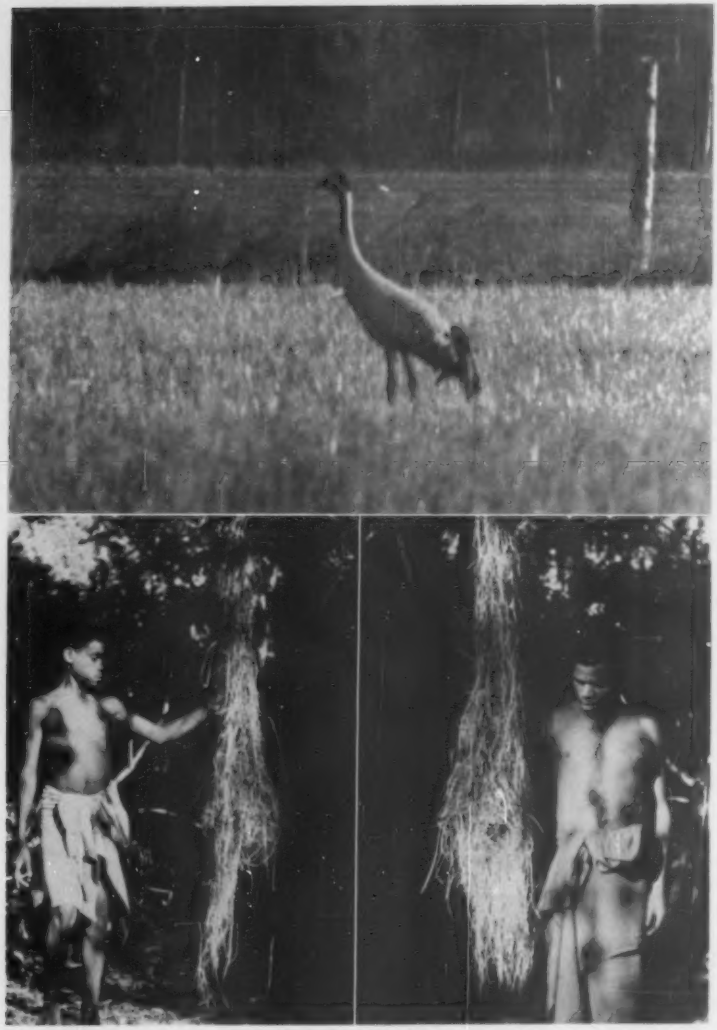
B.O.U. Centenary Celebration

The British Ornithologists' Union will celebrate its centenary from 20 to 23 March 1959 by a symposium with the theme "Progress and Prospects in Ornithology", at the University of Cambridge, England. Those interested in attending and wishing details should communicate with the Hon. Secretary of the B.O.U., Mr. Guy Mountfort, c/o Bird Room, British Museum (Natural History), Cromwell Road, London, S.W. 7, England.

Acknowledgment of Assistance

With this closing number of volume 75, the Editor wishes to thank his fellow bird students (professional and amateur), too numerous to mention by name, for aid of all sorts and particularly for critical appraisal of manuscripts. The members of the editorial committee have been especially generous in making available their time and experience. Paul A. Buckley has assisted as a volunteer in the tedious task of proofreading three numbers of this volume.



(*Above*) Common Crane, *Grus grus*, near Fairbanks, Alaska. Photo May 2, 1958 by Earl L. Schene.

(*Below*) Side and front view of nest of *Pomatostomus isidori*, Finisterre Mountains, New Guinea. Photos by E. Thomas Gilliard.

GENERAL NOTES

First North American Sighting and Photographic Record of Common Crane, *Grus grus*.—A Common Crane, *Grus grus*, a Eurasian species, was first seen on April 24, 1958, feeding in the fields at Creamer's Dairy Farm about two miles west of Fairbanks, Alaska. It was readily identified by the light-gray body plumage, the striking black and white head and neck pattern, and the conspicuous "bustle" formed by the inner secondary feathers. During the next two weeks it was seen regularly in the Fairbanks area. It alternated much of the time between Creamer's fields and the fields of the Alaska Agricultural Experiment Station at College, a distance of about three miles. Twice it was reported in the vicinity of Badger Road, about seven miles from Creamer's Dairy. The crane was observed regularly until May 10, but with the possible exception of a report on June 2, it has not been seen since. The attached photograph was taken on May 2, 1958 by Earl L. Schene (Plate 22).

During its stay in the area, the crane was observed a number of times for lengthy periods from a distance of 200 to 300 yards with a 30X spotting scope. The bird appeared to be in sub-adult plumage, since it lacked the typical red crown patch of the adult. It was extremely wary and could not be collected, but several diagnostic photographs were obtained (see Plate 22). The crane frequently was seen feeding and resting with flocks of Canada Geese, *Branta canadensis*, one of the early migrants through the area; when flushed, it usually landed again near the geese. The Sandhill Cranes, *Grus canadensis*, did not arrive until April 28, and the Common Crane showed no particular affinity toward them after they arrived. Throughout the afternoon of April 24, while feeding among about 350 geese, the crane was harassed by several Common Ravens, *Corvus corax*. The ravens pecked at its drooping secondaries, flew over its back, dived at it and at times actually struck it on the back. Several times they forced the crane to fly a short distance in an attempt to rid itself of its persecutors.

Grus grus is normally a breeding bird of Europe and Asia. The eastern subspecies, *G. g. lilfordi*, winters as far east as the lowlands of eastern and southeastern China, and summers about as far north in eastern Siberia as 65° N. Latitude and apparently east to the vicinity of the Kolyma River, 155–160° E. Longitude, about 1700 miles from Fairbanks, Alaska. It is said to be paler than the nominate subspecies, which breeds in Europe and western Asia, wintering to Africa.—Brina Kessel and Robert W. Kelly, *University of Alaska, College, Alaska.*

A New Form of Nest in the Scimitar Babblers, Pomatorhinini.—Captain Delacour (L'Oiseau et la R.F.O. 1946:23; 1950: 186) has pointed out that the scimitar babblers of the Indomalayan and Australian regions are morphologically so similar that they seem to be congeneric whereas, from a study of their nidification, they appear to belong to two distinct genera. These are an Indomalayan group (*Pomatorhinus* with five species), which construct a large globular nest cradled on the ground (Smythies, "The Birds of Burma" 1953: 25–26) and an Australian group (*Pomatostomus* with four species) which construct a large globular nest cradled in high forks of trees (Serventy and Whittell, "Birds of Western Australia" 1951: 283 and 285). One of the species (*P. isidori* of New Guinea) was included in the latter group on geographical grounds, pending discovery and study of its nest.

In 1956 in the Finisterre Mountains of New Guinea I stumbled on information concerning an extraordinary nest built by a bird which was quite unknown to me.

This nest was later identified by Dr. Ernst Mayr as that of *Pomatostomus isidori*, the one still awaiting discovery. Dr. Mayr made the identification on the basis of feathers found in the nest-lining and the field observations recorded below.

As will be seen from the photographs (Plate 22), the nest of this species differs markedly from that of the other scimitar babblers, it being a pensile rather than a cradled nest. This is of much interest because of the importance attached to patterns of nidification in these babblers, in which nest form, more than any other character, is used as an expression of systematic difference.

The details of this find are as follows: On July 4, 1956 at 6:10 p.m., while I was observing birds in the Finisterre Mountains (Mt. Tyo; altitude 1600 feet), a band of four birds came through the dark understory of a high semi-open forest. They kept close to the ground and uttered grating, plaintive *keeaa* notes. The birds, which appeared brown with longer than average bills, were the size of a Catbird (*Dumetella carolinensis*). They flew in stages of eight to fifteen feet, keeping together in an open band. As I was trying to make out the identity of these late dusk travelers, my native assistant Maropa (a middle-aged man from the village of Bogadjim who was the best naturalist among my carriers) informed me that the birds were going to a nest to sleep. I then recorded in my journal his description of their roosting nest which, he said, was pensile with a hole in the side and fifteen to twenty-five feet up in the forest. Maropa emphasized that the nest was always suspended from a single vine—"rope noting," he called it in Pidgin. He also said that the native method of catching these birds, which he called Cora-cora, was to trap them in the nest after nightfall. Maropa claimed to have once trapped three fully grown birds that were sleeping in such a nest. He stated that the nests were well known to his people but that they were thinly distributed through the forest.

Later, without consulting me, Maropa travelled a long distance to collect the nest which is shown in the accompanying illustration. After photographing, measuring and collecting some of the lining, I made an usuccessful attempt to visit the spot where it had been collected. The details of this nest, which are given below, and the following observations, that were made on July 6 in the afternoon during the course of an all-day vigil under the display limbs of a King Bird of Paradise, are all I have in my journals about the Scimitar Babbler: "Flock of babblers. Size of brown thrasher. Breast and lower neck cinnamon brown. Head and throat mouse gray. A noisy group. Flight in trees rushing and accompanied by squeaky "White-white-throw-white" notes. Feeding and chasing in low crown [35 feet up]. Often heard, not often seen. Elusive. Move through forest very rapidly."

The nest was constructed largely of wild pandanus leaf strippings and other dried fibres. These were intertwined to form a structure that measured six feet six inches in length and one foot in maximum width. This large structure was attached to a single vine which was half the diameter of a pencil. As in all scimitar babblers, the nest was domed and the entrance consisted of a hole in the side. Below the egg cavity there hung a long "beard" of leaf strippings which appeared to serve as camouflage for the nest. The nest hole, which was 50 mm. wide, was near the bottom of the nest and only about 45 mm. above the floor of the egg cavity. This cavity was 135 mm. wide and about 145 mm. high. It was lined with green bamboo leaves, thin pandanus strippings, and a few skeletonized tree leaves. Also included were a number of brown feathers. Some seven of these were collected. All belonged to *P. isidori*.

When I realized that I would be unable to visit the spot where Maropa had collected the nest, I instructed him to walk with me in the forest and to find a similar nest location. He pointed out a spot 35 to 40 feet up in high open forest and indicated that the nest had been suspended about ten feet out from the nearest tree trunk, also that the nest itself had dangled about four feet below a slender limb. In view of the accuracy of his other information concerning this nest, it is most probable that these statements are also exact.—E. THOMAS GILLIARD, *American Museum of Natural History, New York 24, N. Y.*

Extralimital Records for the Eastern Kingbird, Tree Swallow, and Blackpoll Warbler.—Eastern Kingbird, *Tyrannus tyrannus*. Jones (1859, p. 26) listed the "Tyrant Fly-Catcher" as numerous in Bermuda in April, 1850. Capt. Reid (1884, pp. 205–206) recorded a number in April, 1875, took several specimens, and reported others at Hungry Bay, September 22 of the same year. Three of Reid's skins are in the collection of the British Museum (Natural History) in London where I examined them in June, 1958. The published records mentioned were included in the first draft of the Fifth Edition of the A.O.U. Check-list (1957), but through an oversight Bermuda was omitted in the final manuscript.

In addition to the Bermuda skins, there is another in the British Museum collections from Cocos Island, off the Pacific coast of Costa Rica, the first to be reported from that distant point. A note attached to the specimen reads in part "Collected by Percy Howe at Wafer Bay, Cocos Island on 15th November, 1932. The bird * * * was exhausted and taking cover just behind the camp in cleared ground. It is the only one seen of its kind during a year's residence on the Island."

Tree Swallow, *Iridoprocne bicolor*. There is a skin of an immature female, taken on Swan Island (Caribbean Sea), November 14, 1937, in the British Museum (Natural History) that constitutes the only report for this island group. The record was made by Jean Delacour while on a cruise with Lord Moyne on the yacht *Rosaura*, Tree Swallows being noted first (Delacour, 1938, p. 544) among other migrants on October 20, while the skin was obtained on a later visit during the cruise. There are also 3 males of this species in the same museum taken by C. H. Lankester February 4, 1918, at Colonia El Salvador, Province of Heredia, on the Caribbean slope of northeastern Costa Rica. To these I add the occurrence of this swallow near Changuinola, Province of Bocas del Toro, Panamá, where I saw more than 100 on January 17, 1958, and where on March 4 I shot a male from a group of several flying with Barn and Rough-winged Swallows. The locality last-mentioned is the farthest south at which the species has been recorded to date.

Blackpoll Warbler, *Dendroica striata*. In view of the lack of Central American records of this species, except for one from Oaxaca, it is of interest to report an old specimen in the British Museum, labelled "Panama. J. McLeannan," received with the Tweeddale Collection. To students of the birds of Panamá the name "J. McLeannan" is well known as that of a station-master on the Panama Railroad who was an ardent collector of birds and other natural history material for a period of more than ten years, beginning in the late 1850's. McLeannan sent many skins to George N. Lawrence in New York and to Osbert Salvin in London. After having handled hundreds of McLeannan's specimens I am certain that the Tweeddale skin is properly labelled as to source, since it exhibits the peculiarities, particularly in the method of sewing shut the bill, characteristic of McLeannan's work in his later years. The bird is an adult male in full spring plumage, and constitutes the only specimen record to date for Panamá.

McLeannan's ornithological activities were centered along the line of the Panamá Railroad, mainly on the Atlantic side near the station of Lion Hill, now submerged in Gatun Lake. The record of the Blackpoll Warbler therefore is to be attributed to what is now the Canal Zone. The species is only a straggler in Central America as it moves through the West Indies in its migrations. The only previous reports for Panamá are two sight observations for Barro Colorado Island in Gatun Lake, mentioned by Eisenmann (1952: 51, footnote).

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Alexander Wetmore, c/o Smithsonian Institution, Washington 25, D. C.

Notes from the North Polar Region.—An eastern White-crowned Sparrow (*Zonotrichia l. leucophrys*) was collected by Airman 1/c John Mathews on Fletcher's Ice Island (T-3), when at lat. 82° 37′ N., long. 99° 50′ W. on June 16, 1957, and identified by J. C. Greenway, Jr., who found it to be an adult female in slightly worn plumage with minute ovary. It is no. 184971 of the Museum of Comparative Zoology. Airman Mathews said there were several birds resembling White-crowned Sparrows seen quite frequently at the time the specimen was taken. They were not noted on Fletcher's Ice Island after the first of July. Paynter (Auk, 72: 79, 1955) has briefly described this island of ice drifting in the Polar Sea.

Additions to Paynter's list of birds observed there, all from the spring and summer of 1957, follow: We saw Ivory Gulls (*Pagophila eburnea*) regularly from late May until the last of August. During the last week of May I positively identified one Great Black-backed Gull (*Larus marinus*) sitting on the ice about five hundred yards away, observed for about twenty minutes through the telescope of a theodolite. One Kittiwake (*Rissa*) was seen flying overhead at about the same date. On four or five occasions in June and July I saw a land bird, which I did not identify. It had a low, swerving flight with a rapid wing beat. Its swept-back wings suggested those of a swift; head and upper surface seemed dark, possibly dark blue, breast and underparts were light, perhaps buff or pale orange, shading off to very pale on the belly. Its cry, heard in flight four or five times, was a double-noted, short, clipped, high-pitched *beep beep* or *eep-eep*. Once I saw this bird rest briefly on the ground out of sight behind a rock (there are a very few here); when I approached it flew away.—Spencer Apollonio, *Fletcher's Ice Island, T-3, APO 23, New York, N. Y.*

An Ash-throated Flycatcher (*Myiarchus cinerascens cinerascens*) in Maryland.—On November 26, 1957 I collected an immature male Ash-throated Flycatcher that had been seen daily since November 22 by Richard A. Simon on our property at Monkton, Maryland. Dr. John W. Aldrich identified the bird as belonging to the nominate race, and the specimen is now #465388 in the United States National Museum collection. Another specimen (now in U. S. Natl. Mus.) was collected at Beltsville, Maryland, on Nov. 25, 1911, by E. B. Marshall, and identified many years later as an Ash-throated Flycatcher by Samuel Arny, but not recorded in the literature.

Mr. Robert T. Mitchell of the Patuxent Research Refuge, Laurel, Maryland, examined the droppings that were collected during the 24-hour period that the bird was kept alive. Of the 0.5 cc analyzed, three grasshoppers comprised 85 per cent, skin of fruit 10 per cent and undetermined insect (?) fragments 5 per cent. The breast feathers of the bird were infested with feather lice and their eggs. The body has been preserved in alcohol, and will be examined for internal parasites.

There are a few other records for this western species east of the Mississippi River, only two of which are mentioned in the A.O.U. Check-list (1957). One was collected five miles south of Baton Rouge, Louisiana, on March 20, 1943, by Howell (Univ. of Kansas, Pub. Mus. Nat. Hist., 1:186, 1947). Another was collected near Pensacola, Florida, on Dec. 24, 1944, by F. M. Weston (Auk, 63:451, 1946), who observed another individual in the same area on Oct. 21, 1956 (Florida Naturalist, 30:30–31, 1957). Finally, an Ash-throated Flycatcher was reported seen on the Little Creek, Virginia, 1957 Christmas Bird Count (Audubon Field Notes, 12:125, 1958). Dr. George Lowery, Jr. informs me that in the Louisiana State University Museum are three additional specimens taken in Louisiana, west of the Mississippi: False River, Point Coupee Parish, Dec. 23, 1945; Johnson Bayou, Cameron Parish, Jan. 4, 1948; Willow Island, Cameron Parish, April 1, 1957.

It was interesting to note that the flycatcher at Monkton frequented only the lowest branches of the trees scattered throughout and surrounding an open field. It was never observed higher than six feet. A wintering Mockingbird was seen chasing the flycatcher on several occasions.—STEPHEN W. SIMON, *Blue Mount Road, Monkton, Maryland.*

Systematic Notes on the Olive Warbler.—The attractive Olive Warbler, (*Peucedramus taeniatus*) inhabits high mountain pine forests from central Arizona south to Nicaragua. While related to the large genus *Dendroica*, it has for many years been segregated as a closely allied, monotypic genus. Griscom (1957, "The Warblers of America," Devin-Adair Company, New York, p. 349) recently recommended merging *Peucedramus* with *Dendroica*, a move with which I agree. I have, below, presented evidence which weakens one of the alleged generic distinctions. The only real revision of the species was by Miller and Griscom (1925, Amer. Mus. Nov., 183:1–14).

As appears from the map, my distributional and taxonomic conclusions generally confirm those of Miller and Griscom (*op. cit.*) and of Zimmer (Auk, 65: 126, 1948), but the range of *jaliscensis* is considerably extended. I find myself at variance with the arrangement of the Mexican Check-list (Pac. Coast Avif., 33: 244, 1957), which treats *jaliscensis* and *giraudi* as synonyms of *taeniatus*. There are additional color characters not heretofore described for some of the races. I studied a series of 310 skins. Obviously this report is not definitive; however, until adequate autumn collections are made in Mexico and Central America little more can be done.

FIGURE 1. Distribution of the Olive Warbler. Each locality from which one or more specimens was examined in the present study is indicated by a dot. Subspecies ranges are delimited by narrow, solid lines, but only pine islands are inhabited within these extensive areas. Dotted lines bound the States of Mexico; wide, solid lines mark international boundaries.

I want to acknowledge the help of Dr. Robert T. Orr at the California Academy of Sciences and of Dr. Allan R. Phillips in the field. I am indebted to Dr. Phillips and Dr. George M. Sutton for the loan of specimens from their private collections and to the curators of the American Museum of Natural History, the Museum of Vertebrate Zoology of the University of California, the Chicago Natural History Museum, the University of Kansas Museum of Zoology, the University of Michigan Museum of Zoology, the University of Minnesota Museum of Natural History, and the United States National Museum for the loan of specimens.

A resume of the material studied is:

Peucedramus taeniatus arizonae (Miller and Griscom), Amer. Mus. Nov., 183:10, 1925 (Chiricahua Mts., Arizona).

Generally paler, grayer, and less green than the more southerly races; fresh-plumaged birds of all ages and both sexes are also browner-backed.

Material from northwestern Chihuahua averages slightly smaller, with adult males blacker-backed than those of Arizona, New Mexico, and northwestern Coahuila.

Specimens examined—Southeastern Arizona, 103 (Santa Rita, Chiricahua, and Huachuca Mts.); Southwestern New Mexico, 40 (Reserve); Northwestern Coahuila, 15 (Sierra del Carmen); Northwestern Chihuahua, 34 (Pacheco, Babicora, Garcia).

Peucedramus taeniatus jaliscensis (Miller and Griscom), Amer. Mus. Nov., 183:9, 1925 (Zapotlan=Cuidad Guzman, Jalisco).

Blacker-backed than *arizonae* in worn plumage, and darker and less brownish-olive in fresh plumage. As compared with *giraudi*, the green dorsal wash is lacking; the head and neck are paler, less bright orange in both immature and adult males

in fresh plumage; the edgings of the flight feathers are paler, less green. As compared with *taeniatus*, fresh-plumaged adult males have a darker, less yellowish shade of ochraceous about the head.

The population in southern Jalisco is paler, less blackish-backed than the more northern populations. It is *not* particularly small, as stated by Miller and Griscom (*op. cit.*). The extensive population of the Sierra Madre Occidental and Sierra Madre Oriental is darker, blacker-backed than the rest of the race. The population of the isolated Sierra de Tamaulipas is almost distinct enough (distinguishable 67 per cent from 100 per cent on size, and about the same on color) to be a subspecies. The series which I studied was the same group of six reported on by Martin, Robins, and Heed (Wilson Bull., 66:38-57, 1954). I find this series averages smaller, less extensively yellow-throated, and paler greenish-edged on the flight feathers than other *jaliscensis*; it is 100 per cent distinguishable from *arizonae*.

Two immature specimens from central western Coahuila are almost as close to *arizonae* as to *jaliscensis*. They lack the brownish-olive back color of *arizonae*, however.

Specimens examined.—Southern Jalisco, 11 (La Pisagua, 9 miles west of Ciudad Guzman, La Canoas, Volcan de Colima, Sierra Nevada de Colima); northcentral Jalisco, 1 (La Venta del Astillero, January, a migrant); Nayarit, 2 (near Tepic, January and February, possibly migrants); Zacatecas, 8 (Laguna Valderama, west of Milpillas); Durango, 10 (Laguna del Progreso, Coyotes, Otinapa, El Salto, Adjuntas); southern Chihuahua, 1 (Lagunita); western Tamaulipas, 1 (La Joya de Salas); Sierra de Tamaulipas, 6 (Acuna); central Coahuila, 2 (22 miles south of Ocampo).

Peucedramus taeniatus giraudi Zimmer, Auk, 65:126, 1948 (Las Vigas, Vera Cruz).

Back much greener than in any of the other races. As compared with *taeniatus*, males darker, duller, more orange about the head, and larger. As compared with *arizonae* and *jaliscensis*, fresh-plumaged birds of both sexes slightly brighter orange or yellow about the head.

Specimens examined: Vera Cruz—14 (Perote, Las Vigas); Estado de Mexico—9 (Mt. Popocatepetl, Rio Frio, Villa Victoria, Volcan Toluca); Distrito Federal—5 (La Cima, San Andres); Morelos—1 (Tres Cumbres); Michoacan—13 (Patzcuaro, Tancitaro, Uruapan, Zitacuaro); northcentral Jalisco—2 (near Tequila, Sierra de Cuyutlan). One specimen from Guerrero (male, wing 79 mm.) taken December 1, 1941, at Cuapongo, is a migrant or a vagrant of this race.

Peucedramus taeniatus taeniatus (du Bus), Bull. Acad. Roy. Sci. Lettr. Beaux-Arts, Belgique, 14, p. 2:104, 1847 (San Pedro, Oaxaca, or Chiapas, near Tabasco border).

As compared with the more northern races, adult males brighter, more yellowish orange on the head, neck, and throat; females more orangish yellow about the head; both sexes with back more leaden gray and with the dorsal green of *giraudi* lacking; size smaller. Larger than *micrus*.

Males from Guerrero and Oaxaca are somewhat paler backed than those from Chiapas.

Specimens examined—Guerrero—2 (Omilteme, Cuapongo); Oaxaca—3 (La Parada; 25 miles northwest of Oaxaca City); Chiapas—13 (San Cristobal, Comitan, Volcan Tacana).

Peucedramus taeniatus micrus (Miller and Griscom), Amer. Mus. Nov., 183:10, 1925 (San Rafael del Norte, Nicaragua).

Very similar in color to the darker specimens of *taeniatus*, from Chiapas, but smaller and with wider bill than that of any other race.

Specimens examined—El Salvador—2 (Dept. Chalatenango).

TABLE 1

MEASUREMENTS IN MILLIMETERS OF ADULT-PLUMAGED MALES OF *Peucedramus taeniatus*. AVERAGES IN PARENTHESES.

		Wing	*Tail*
arizonae	46 Arizona, New Mexico	75–80 (77.6)	47–54 (50.5)
	7 Northwestern Coahuila	76–81 (78.3)	49–54 (51.9)
	18 Northwestern Chihuahua	74–78 (76.3)	48–52 (50.2)
jaliscensis	11 Durango, Zacatecas, southwestern Chihuahua	73–80 (76.6)	46–53 (50.0)
	1 Southwestern Tamaulipas	78	51
	4 Sierra de Tamaulipas	69–75 (73.0)	46–50 (47.7)
	6 Southern Jalisco	75–79 (77.3)	46–52 (49.2)
giraudi	11 Michoacan and north-central Jalisco	75–79 (76.4)	47–54 (49.6)
	15 Vera Cruz, Morelos, State of Mex., Distrito Federal	73–79 (76.3)	47–54 (51.3)
taeniatus	5 Oaxaca, Guerrero	70–75 (73.0)	48–51 (49.2)
	6 Chiapas	71–76 (73.5)	47–54 (49.7)
micrus	1 El Salvador	70	51

The Olive Warbler has usually been regarded (*e.g.*, Bent, 1953, Bull. U. S. Natl. Mus., 203:153–160) as slightly migratory. In the present study, two specimens were identified as migrants or winter wanderers. As noted above, they were an adult male of *jaliscensis*, evidently of the Sierra Madre Occidental population, taken near Guadalajara in January, and an adult male of *giraudi*, taken in Guerrero in February. I conclude that some individuals, but not entire populations, move as much as 100 miles in winter.

According to Ridgway (Bull. U. S. Natl. Mus., 50 (2):495 1902) and Bent (*op. cit.*), the male Olive Warbler acquires adult plumage at the first postnuptial molt, when it is about 14 months old. I find that this is not invariably true. Two males prepared by Ernest P. Edwards in 1952—July 29 at Rio Frio, State of Mexico, and August 13, 25 miles northwest of Oaxaca City, Oaxaca—have about one-half completed a postjuvenal molt directly from juvenal plumage to adult male dress. In each case, Dr. Edwards noted the testes as minute and the skull as immature (not granulated).

In connection with the above observation of variability as to the time of acquisition of adult plumage, the following data on specimens examined are suggestive: Of males in worn plumage, taken from March through early August, there were of *arizonae* 56 in adult plumage and 36 in first year (female type) plumage. These same figures for *jaliscensis* were 19 adult and 1 (questionable: "sex?" on label) first year; for *giraudi* 17 adult and 4 first year; for *taeniatus, aurantiacus,* and *micrus,* together, 7 adult and no first year. It seems that the trait of the male

Olive Warbler taking over a year to acquire adult plumage is more characteristic of *arizonae* than of more southern races. Such geographic variability throws doubt on the use of this molt character as a generic distinction, as was done by Bent (*op. cit.*) and Chapman (1907, "The Warblers of North America," D. Appleton & Co., New York, p. 110).—J. Dan Webster, *Hanover College, Hanover, Indiana, and California Academy of Sciences, San Francisco, California.*

Unusual Nest and Nesting Behavior of a Mourning Warbler.—While studying the breeding biology of the Mourning Warbler (*Oporornis philadelphia*) at the University of Minnesota Forestry and Biological Station in Itasca Park, Minnesota, the writer found on June 21, 1956, a nest containing three eggs of the owner and one of the Brown-headed Cowbird (*Molothrus ater*). The latter egg was removed. The nest was located at the edge of a clump of raspberry (*Rubus* sp.) in a clearing in the forest. It was supported about 5.5 inches from the ground by several small dead branches.

The nest was peculiar in having two cavities instead of a single open cup. It was shallow and elongate, measured 9 inches in length, 5.5 inches in width and 3.5 inches in height. The depths of the cavities were 1.5 inches and 1 inch. The diameter of the deeper cavity was 2.5 inches and the overall inside diameter of the nest, including both cavities and the area between them, was 6.5 inches. Three other normal nests examined by the writer averaged 4.3 inches in outside diameter, 3.7 inches in height, 1.9 inches in depth of cavity, and 2.2 inches in inside diameter. Both cavities of the nest under consideration were poorly lined. The eggs were in the deeper of the two cavities.

The extra cavity, although never containing eggs or young, apparently stimulated incubating and brooding responses in the female. During attentive periods of incubation, when the female faced the secondary cavity, she would often hop from the main cavity to the secondary one. In many cases she did not settle but simply paused a few seconds and hopped back into the main cavity. At other times she settled, usually facing away from the main cavity. In settling, she used the same side-to-side rocking motion employed in settling on the eggs or young. The usual time spent in the secondary cavity was 10 seconds to 1.5 minutes although she occasionally remained as long as 3 minutes. Sometimes the female would resettle and was even seen to rise and poke in the cavity as though moving eggs or rearranging the nest lining. Visits to this secondary cavity occurred usually from 1–4 times during each attentive period of incubation, which averaged about 28 minutes in length in this female. This behavior continued after the young had hatched, although the time spent in the secondary cavity was less.

The construction of the nest was also responsible for the death of the young. In addition to being shallow, the nest was slightly tilted, making it easy for the young to fall out. On the morning of July 7, two young (one egg failed to hatch) were found on the ground beneath the nest. Although cold and feeble, they were still alive and were replaced in the nest. The side of the nest was propped up with a small stick, but despite this the young were found dead beneath the nest the next morning.

The writer wishes to thank George C. West and Richard Brewer for suggestions regarding the manuscript.—George W. Cox, *University of Illinois, Urbana, Illinois.*

Pied-billed Grebes Mistake Highway for Water.—It is interesting to speculate upon the frequency with which birds, in flight or migration, make mistakes

in identification of landmarks. During an exceptionally heavy rainstorm in the early morning hours of April 18, 1958, as we were driving on Texas State Highway 27 between Kerrville and Ingram, Kerr Co., Texas, we noticed two Pied-billed Grebes (*Podilymbus podiceps*) in the south center lane of the road, a quarter of a mile apart.

At the time the birds were observed (1:30 A.M.) the night was very dark and the rain exceedingly heavy, so that the road was running with water, stippled with raindrops, and reflected the sheen of headlight glare in a manner similar to that of bodies of water. The first bird was located only 200 yards west of a small bridge and dam on Goat Creek, and the highway runs parallel to the Guadalupe River, some half a mile to the south. It would seem plausible that the birds were forced down by gusts and rain and landed on the road—mistaking it for the river or the creek.

Both birds were alive, and remained sitting in the "decoy position" despite the passing of the car. After observing the second bird, we returned to investigate it further, and drove the car to within two feet without disturbing it. The senior author, by leaping out from behind the headlights, was able to catch it by hand. Presumably the birds, unable to dive or take off, were confused by the lights and did not know what to do. The captive bird was completely uninjured, showed no ill effects, and was later released. The first grebe had been run over and killed by the time we reached it again, not five minutes later.—Henry L. Short and David E. Craigie, *Division of Vertebrate Ecology, The Johns Hopkins University, Baltimore 5, Maryland.*

Treatment of Foot Pox at a Feeding and Trapping Station.—During the fall of 1957 the incidence of "foot pox" became increasingly prevalent, particularly in the House Finches (*Carpodacus mexicanus*) frequenting our feeding and trapping areas located in the chaparral above Hollywood. This affliction increased greatly during the late fall and early winter and gradually began to extend to other species, including Brown Towhees (*Pipilo fuscus*), Oregon Juncos (*Junco oreganus*), White-crowned Sparrows (*Zonotrichia leucophrys*), Fox Sparrows (*Passerella iliaca*) and Golden-crowned Sparrows (*Zonotrichia atricapilla*). The incidence among all of the other species was, of course, considerably lower than that of the House Finches (*Carpodacus mexicanus*), which proved to be the carrier.

"Foot pox" is a viral infection called Avian Lymphomatosis, caused by a microorganism which enters the foot usually between the scale openings, but also can be contracted orally and through open lesions. In its usual form it affects the foot of the bird, causing swelling, scaling and eventually gangrene, resulting in the loss of first the nails, then complete toes and eventually in the loss of the complete foot. It also causes protuberances about the face, eyes and base of the mandible. The incidence of fatality is very high. In addition to the species mentioned we have found it to occur in Anna's Hummingbird and Abert's Towhee. Different strains of this disease affect various groups of birds, when this infection occurs in chickens, pigeons, it is known as "fowl pox." Mr. Merton Rosen of the Department of Fish and Game, State of California, has been kind enough to confirm my diagnosis of the disease in birds I had captured and kept for him to check.

As preventive measures all of the feeding areas were sterilized; solutions of carbolic acid were used, which proved to be effective in killing the causative organism. We then conducted a series of experiments, using the House Finches (*Carpodacus mexicanus*) and found that the disease could be transferred through

the same perches being used by both diseased and healthy birds. Examination showed that living organisms were exuded from infected feet, and wherever contact had been made either through feet or through intake of food, the bird ingesting such food could become infected. We further explored the possibility that birds in traps might make contact when putting their bills through the mesh and infect the base of their upper mandibles. Since some of the birds which contracted the disease were old favorites at my banding stations, various infected birds were kept and given individual treatment using several different materials in an effort to alleviate the condition. The most successful treatment consisted of a daily injection of a solution of streptomycin sulphate in a proportion of .008 grams per cc, with a dosage of one minim per day per ounce of body weight—for a five-day period. This made the dosage per ounce of body weight of streptomycin sulphate .0005 grams. The injections were made into the upper leg muscle, using a 1 cc tuberculin syringe and a #27 gauge ½ inch needle.

Using this five day treatment on Brown Towhees, Oregon Juncos, House Finches, Golden-crowned Sparrows and one Fox Sparrow, we found that all of the birds responded well, with the exception of one junco in which the disease had already progressed so far that the entire head was involved in lesions and swelling. This bird succumbed the day following the start of the treatment. The balance of the birds that had lesions on both the feet and around the bill and head immediately improved, and within a short period of time the lesions healed and the birds were released, apparently in good health with the exception of the scar tissue formed where the lesions had existed.—Don Bleitz, *Bleitz Wildlife Foundation, Los Angeles 38, California.*

A Winter Roost of Purple Finches (*Carpodacus purpureus*).—Not finding any reference in the literature to communal roosting of Purple Finches, my observations of one in Nashville, Tennessee from December, 1957 to May 1, 1958 are worthy of note.

During the 1956–1957 fall and winter season, no Purple Finches were found in the Nashville area (1957, Audubon Field Notes, 11 (3) :274), but on October 20, 1957, the arrival of a singing male in a city park was reported by H. C. Monk. On the afternoon of December 19, 1957, I found a group of ten perched in a bare deciduous tree on a hillside thickly grown with cedar, interspersed with deciduous trees, on the south edge of Davidson County where suburban residence property adjoins farmland, and where I had been making regular weekly field trips. On later dates the number of birds arriving gradually increased and I found that they were using the densely-foliaged cedar trees as a roost.

On January 9, 1958, we counted 192 Purple Finches and a few Goldfinches (*Spinus tristis*) that could be seen from the roadside. This doubtless did not include the total number because it was impossible to enter the fenced woodland to examine the entire area which extended .3 of a mile along the road and a considerable distance north toward Nashville.

On the numerous occasions that I watched, usually with the aid of other observers, and attempted to count the birds as they went to roost, their behavior followed a regular pattern. On account of the sloping terrain and the obscuring evergreens, it was necessary for observers to take stations at intervals along the roadside. Small groups of birds began to arrive from the Nashville side of the woods and alighted in a deciduous tree to perch for a few minutes or perhaps for a half hour before dropping into the nearest cedar. Occasionally one or a few

would return to a bare tree for a short time before settling for the night. Early in the season, birds began assembling about 2:45 p.m. and all had gone to roost by 4:00 p.m., but as the days lengthened, arrival and roosting were correspondingly later.

A few of the birds occupied a small roost in cedar trees in an estate adjoining Percy Warner Park on the same road nearly a mile west, but the main concentration was in the larger area until a disturbance occurred there in mid-January. One afternoon when most of the birds had settled, something (unseen) frightened those in one tree and over twenty Purple Finches flew out and across the road. A few days later, it was noted that the larger number of the birds had moved to another cedar wood on the same road several hundred feet further east. On February 6 at 4:00 p.m., we found the flock using the three locations; the largest concentrations were in the most easterly area.

During winter days, Purple Finches were found feeding in residence areas on seeds fallen to the ground and upon the red fruit of coral berries (*Symphoricarpos orbiculatus*), locally called buck bushes. In March, elm seeds were the favorite food. In spring they also eat hackberries here, but this year the supply had been exhausted in early winter.

By April the numbers using the roosting places had decreased noticeably. The last, a group of 9 birds, was seen in the roost on May 1. On May 3, when 15 observers in several parties spent the day afield in the Nashville area, no Purple Finches were found.—Amelia R. Laskey, *1521 Graybar Lane, Nashville 12, Tenn.*

Variation of Egg Size with Age of Parent.—It is well known that pullets lay smaller eggs than fully mature domestic fowls or "chickens." The Romanoffs (1949:67–69) discuss this briefly in terms of the weight of the egg. Their own results and those of other investigators reviewed by them, agree that the weight of the egg tends to increase during the first two or three years of the bird's life, and then to fall off, reaching in old age lower values even than those of pullets. This naturally raises the question as to whether something similar happens with other species in the wild. The evidence appears to be somewhat scanty, but on the whole to be confirmatory, at least for species that take more than one year to become fully mature, *i.e.*, for large birds.

Dixon (1937-50) in his studies of the Golden Eagle (*Aquila chrysaëtos*) found a definite decrease in the size of the eggs as the birds increase in age. It does not seem to be precluded that no initial gain in size exists, though it was not observed. Dixon comments that as size decreased, shell thickness increased.

Andersen (1951:168–169) on the other hand found that egg size increased, in the case of the Ruff (*Philomachus pugnax*), for the first 2 to 4 years and then decreased (see also Andersen 1957 p. 2). This finding is similar to that of Richdale for Yellow-eyed Penguins (see below).

Andersen (1957:4–5) also reached the conclusion that in the Herring Gull (*Larus argentatus*) mature birds lay eggs of greater breadth than either young or aged birds.

In the case of the Common Tern (*Sterna hirundo*), Gemperle and Preston (1955:196) found that from New Jersey the eggs seemed significantly larger than those in England or New England. In the New Jersey case it was known that they were the first clutches of the season, and may have been laid by older birds. The younger birds might have laid a little later and might have laid smaller eggs, but it was not known to what extent the eggs in England and New England might include eggs of younger birds.

Van Bree (1957:252) suggests that a difference in size in two groups of Black-Headed Gulls (*Larus ridibundus*) may be due to the older birds laying the larger eggs. A careful reading of the text suggests that "older" here means more mature and vigorous.

Richdale (1957:113–115) in his studies of Yellow-eyed Penguins (*Megadyptes antipodes*) found that length of eggs increased for several years, but decreased in old age. He found that the egg width also increased and then declined in a somewhat similar fashion, and a very similar phenomenon was true of egg weights.

Perhaps I might add here that in the course of our measurements of the eggs of several hundred species of North American birds, we seem to be finding that the least variable quantity is the breadth, not the length, still less the end curvatures that effectively define shape. In other words, of the readily measurable dimensions of the egg, the standard deviation when expressed as a percentage of the mean, *i.e.*, the "coefficient of variation," is in almost all species less for breadth than for anything else. Thus a "significant" level is reached with more certainty, or less testing, for breadth than for length or shape.

This probably means that in assessing the effect of age upon egg size, it might be well to pay special attention to the breadth of the egg, as Andersen seems to have done, though not for this reason.

The fact that there does seem to be a difference in size of eggs laid by those birds (usually the larger birds) that lay as "pullets" and of those laid by fully mature birds, complicates considerably the problem of defining what is the "average" size of the eggs of such species. This is true even of a well-defined local population of that species, because it depends on the age composition of that population, and this may vary widely from time to time, according to hatching and rearing success of recent seasons.

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F. W. PRESTON, *Box 149, Butler, Pennsylvania.*

Use of Concealing Posture by a Screech Owl.—On December 5, 1955, at the Horticultural Experiment Station, Vineland Station, Ontario, a Screech Owl (*Otus asio*) was noticed perched on an exposed limb about ten feet from the ground and twenty-five feet from a house. It was 4:00 p.m. on a dull, cloudy day and dusk was falling. The owl sat in a partly crouched position with fluffed plumage. A House Sparrow (*Passer domesticus*) flew into a trellis about twenty feet in front of the owl. The latter immediately twisted its body sideways to the sparrow, raised the front margins of the wings slightly and held the rear margins tightly against the back, at the same time compressing the body plumage and so presenting a very narrow silhouette as seen from the sparrow's position. The owl's head continued to face the sparrow. The pose was similar to, if not identical with, the

"concealing" posture that the Screech Owl often assumes on the approach of a person, which is well described by Durfee as quoted by Bent (U. S. Nat. Mus. Bull. 170:255–256, 1938). As I was observing the owl at nearly right angles to the line along which its attention was fixed I could not see whether it had the nearly closed, oblique eye slits and stiffly erect ear tufts of the typical "concealing" position.

After a couple of minutes the sparrow flew away and the owl immediately relaxed into its original position. A group of noisy children and a dog passed within twenty feet of the owl but its only reaction was to turn its head. Soon another sparrow lit on the trellis; the owl immediately resumed the "concealing" posture. Four other sparrows joined the one on the trellis and one by one they dropped to the ground and foraged among fallen leaves, gradually approaching the owl until they were about ten feet from the spot above which it was perched. All the time the owl oriented its posture toward the nearest sparrow, shifting as first one and then another approached nearer. In about ten minutes the sparrows flew away and the owl again sank into its normal position.

If the posture described was indeed the "concealing" one, why was it assumed toward the sparrows but not toward the children? Perhaps the owl was afraid of being mobbed by the sparrows, although I have never seen them bothering any of the numerous owls noticed at the Experiment Station. Or does the Screech Owl assume this posture in the presence of prey? Darkness was approaching and in a short time the owl would probably be hunting.—Wm. L. Putman, *Vineland Station, Ontario, Canada.*

Correcting an Old Albatross Error.—The Peabody Museum of Salem has in its maritime department a collection of some two thousand log books covering voyages to the seven seas, and its curator, Marion Brewington, has called my attention to certain items in them. It seems to have been a fairly common procedure for whalers to mark or band sea birds, often by tying about the neck a small bottle or tin box containing a message, in the hope that it would be found by another vessel and eventually reach home port.

By far the most interesting item refers to a bird mentioned by Robert Cushman Murphy in "Oceanic Birds of South America" (vol. 1: 546, 1936) as follows: "In the Brown University Museum is a manuscript taken from a vial which was found tied to the neck of a Wandering Albatross. The bird was shot off the coast of Chile by Captain Hiram Luther on December 20, 1847, in latitude 45° 50′ S., longitude 78° 27′ W. The note reads: 'Dec. 8th, 1847. Ship 'Euphrates,' Edwards, 16 months out, 2300 barrels of oil, 150 of it sperm. I have not seen a whale for 4 months. Lat. 43° S, long. 148° 40′ W. Thick fog, with rain.' According to these figures, the albatross had travelled 3150 nautical miles (5837 kilometers) as the crow flies during the twelve-day interval between the writing of the manuscript and the shooting of the bird."

The quoted date and locality of capture—and thus the distance of this remarkable flight—appear to be incorrect. Captain Luther wrote in the log book of the Cachalot on December 30, 1847—Latitude 43° 24′ S, Longitude 79° 5′ W: "Caught a Goney with a bottle arond his neck Containing a piece of paper rote by Capt. Edwards, Ship Euphrates of N Bedford, in Lat 43°, South, Long, 148° 40′ W, reporting her with 2300 bbls, 150 of sp oil, 16 mo."

This reveals an error of ten days in elapsed time, plus minor mistakes in both latitude and longitude. As figured at the Peabody Museum the flight covered 3050 miles (by rhumb line) in 22 days, for an average of 138.6 miles a day, instead of

3150 miles in 12 days, averaging 262.5 miles each day. The mistakes apparently occurred because Dr. Murphy copied the item from a newspaper clipping attached to the "goney" he found in the Brown University collection. The original message hung on the bird had long since disappeared (*in litt.*, David A. Jonah, Librarian, Brown University).—DOROTHY E. SNYDER, *The Peabody Museum, Salem, Mass., April 28, 1958.*

The Specific Name of the Bohemian Waxwing.—In the fifth edition (1957) of the A.O.U. "Check-list of North American Birds," the scientific name of the Bohemian Waxwing is given as *Bombycilla garrula* (Linnaeus), as it was in the fourth (1931) and third (1910) editions. Earlier editions placed the waxwings in the genus *Ampelis*, and the Bohemian Waxwing was listed as ***Ampelis garrulus*** (Linnaeus), although *Ampelis* is of feminine gender (Brown, "Composition of Scientific Words," p. 145, 1956). Current European literature is unanimous in giving the specific name a masculine termination, *Bombycilla garrulus* (*cf.* B.O.U. "Check-list of the Birds of Great Britain and Ireland," p. 87, 1952). The use of the feminine spelling "*garrula*" by the A.O.U. Committee in 1910 seems to have been derived from an erroneous impression that the specific name was intended by Linnaeus as an adjective, and must therefore conform in gender with the generic name (in this case, the feminine *Bombycilla*). Linnaeus described the Bohemian Waxwing in the 10th edition of the "Systema Naturae" (vol. 1, p. 95, 1758) as *Lanius Garrulus*, as correctly cited in the new A.O.U. "Check-list" (p. 460). In this edition of the "Systema" Linnaeus used a capital initial letter for his specific names which were intended as substantives in the nominative case, in apposition with the generic name. For adjectival specific names he used a lower-case initial letter. Thus, even when placed in a feminine genus, the name would continue to be spelled *garrulus;* the usage in the first two editions of the A.O.U. "Check-list" (*Ampelis garrulus*) was grammatically correct.

Few birds would be less appropriately called "garrulous" than a waxwing. Linnaeus, however, was not describing an attribute of the bird, but referring to the fact that some earlier writers had placed this species in the jay genus *Garrulus*. This whole question was thoroughly discussed many years ago by A. E. Newton, in his revision of William Yarrell's "History of British Birds" (p. 535–536, London, 1871), as follows:

"The name *Ampelis* was that under which Aldrovandus described the bird in 1599, complaining of Gesner, who had, in 1555, called it *Garrulus Bohemicus*—the Bohemian Jay or Chatterer, and justly remarking that it had nothing to do with birds of the Pie-kind, that it did not chatter nor was it known to be peculiar to Bohemia. Linnaeus, with whom all scientific nomenclature begins, kept what seemed good to him in both these names, using that of Aldrovandus for the genus [in the 12th edition of the 'Systema Naturae'] and Gesner's first word for the species—the general likeness between a Jay and a Waxwing being sufficiently obvious. . . .

"The liberty which many writers have taken with the Linnaean specific name, writing '*garrula*' for '*Garrulus*,' and thus turning a substantive which is in some degree appropriate into an adjective which is not, is also to be condemned."

American usage should thus conform to the correct spelling *Bombycilla garrulus* (Linnaeus) as used abroad, rather than the present spelling of the A.O.U. "Check-list." I am supported in this opinion by Dr. Alexander Wetmore, to whom I am grateful for help in clearing up this nomenclatorial discrepancy.—KENNETH C. PARKES, *Carnegie Museum, Pittsburgh, Pa.*

REVIEWS

Extinct and Vanishing Birds of the World.—James C. Greenway, Jr. Special Publication No. 13, American Committee for International Wild Life Protection, New York, N. Y.; pp. i–x + 1–518; 1 col. pl. and 84 drawings by David Reid-Henry, one drawing by Alexander Seidel; maps and charts. 1958. $5.00.—As Jean Delacour points out in his Foreword to this fascinating volume, "We are now witnessing the most tremendous changes in the world, and one of the saddest consequences is the awful threat to the existence of many forms of wildlife. . . . Birds, conspicuous and easily killed as many of them are, become particularly affected. . . . Furthermore, a large proportion of them (species) are narrowly adapted to certain types of habitats, the destruction of which they cannot survive."

James Greenway, Curator of Birds at the Museum of Comparative Zoology at Harvard University, is well qualified to undertake such a work. As Curator of one of the major world ornithological collections, including specimens of many very rare or extinct species, as an authority on birds of Hawaii, Southeast Asia and the Pacific, he has had first-hand experience observing or studying many of the species of which he writes. It may be asked, "Why is such a volume 'fascinating'? What pressing or exciting interest can be derived from such a melancholy recital of death and despair?" The fact of course is that there is an extraordinary interest in the facts of extinction. From a biological point of view every nub or grain of information about an extinct species is of great potential use. Important information in the fields of evolution, genetics, biogeography, and taxonomy lurks in the slim sheaf of data that we possess about long-extinct species. Species that are suspected of being "on the way out" should be minutely studied in order to document everything of value about their life history. It is even conceivable that some key to their salvation may be discovered in such studies. What could be more appropriate than for man, the despoiler of so much of our natural world, to be able to make partial amends by saving a handful of our presently threatened species?

One of the problems of writing an account of this kind is how to define the boundaries of the subject. Greenway has accomplished this well by breaking his fauna into several categories; an example is those extinct species that are well known from specimens and with well documented histories. Of these he lists 44 species and 43 subspecies. In addition he adopts the conservative category of "probably extinct," under which he lists 12 species and 7 subspecies. A third category is that of birds known from osseous remains, which are in addition well documented, as is the dodo for example. This list contains 20 species. A fourth consists of species known only from pictures and travellers' accounts. This numbers 27 species, and is one most difficult of interpretation. Undoubtedly many of these names represent the result of a certain eagerness on the part of certain authors to spring into print. Many of them rest on the flimsiest of evidence.

A fifth list is perhaps of the most interest to conservationists, Mr. Greenway's list of species and subspecies in grave danger now, for reasons primarily due to man's interference. This list of some forty species and thirty-nine subspecies is again a most conservative one. Most people have assumed that the "huia," for example, *Heteralocha acutirostris* of New Zealand, has been extinct since the early years of this century, although it is placed by Greenway both on his extinct list, and on his list of small populations *threatened* with extinction.

Finally there is a list of some 50 species or subspecies of "rare" birds, birds of which very little is currently known. This last is a highly selective list on the

author's part. Each curator of a large museum collection could probably be challenged to produce his own list of this sort, and it is possible that no two lists would be the same. Of the living birds of the world there are many which are still very little known, at least among men who can communicate with each other about them.

Not all this chronicle is taken up with disaster. The "takahe" or *Notornis* of New Zealand, an enormous, rather grotesque-looking blue gallinule, was rediscovered in 1948 in the mountains of the South Island, after having been considered extinct for 50 years. What a joyful rediscovery, one which prompted the New Zealand Government to set aside a 400,000 acre sanctuary in its honor.

One aspect of the biology of these species should perhaps be emphasized more than it has. What positive steps can be taken to assist some of those which are now gravely threatened? If man has been responsible for the extinction of numerous species of animals, can man himself take the initiative to reverse the tide, even partially? Recent experiments and conservation measures have shown how habitat itself can be preserved. Far less has been done to hold the line with small populations. At the moment an exciting development in this field is the preservation of the "nene" or Hawaiian Goose, *Nesochen sandvicensis*, a species which had dwindled to the vanishing point in the wild state. For nearly ten years until 1955, when a wild flock of 22 birds was sighted, there had been no real sightings of nene in the mountains of Hawaii. But meanwhile painstaking efforts by aviculturists have built up a captive population of now about 75 birds. From these, as with our American Buffalo, a group may be used to be reintroduced gradually back into the wild habitat, which, now that the original human hunting pressure is gone, may again be suitable for the species. If someone could only have kept the Dodo going!

One of the most interesting accounts is that of the Great Auk, *Alca impennis*. Mr. Greenway has summarized the records of Great Auk bones and specimens in such a way as to give a most convincing picture of the distribution of this species, including its former occurrence in Scandinavia in prehistoric times.

I am sorry that the manuscript was finished in 1954 and the book not published until 1958. There is a gap here and there in our up-to-date information about some of the now very rare species which could have been filled. Recently, for example, in 1957, there has been a more encouraging report on the status of the Short-tailed Albatross, *Diomedea albatrus*, from the Japanese Section of the International Committee for Bird Preservation, showing that between six and eight young were reared by their parents on Torishima in 1956. Two Whooping Cranes, *Grus americana*, were reared in captivity in 1957, a possible augury for the future of that species. Experiments are under way with the Laysan Teal, *Anas laysanensis*, which similarly may serve to cushion that little relict population against extinction.

One of the very interesting sections of the Greenway book is that on the geography of extinction, which shows very clearly what a biological trap a small island may be for the populations which have evolved upon them. Selection in small island populations seems to push ruthlessly towards the abandonment or loss of those attributes which might have protected the population under continental conditions of competition and predation. Let the environment change, let predators from the outside world be introduced and the island is no more a refugium, an elysium. The West Indies, many of the Pacific Islands, contain numerous examples of species which, having settled on insulated islands, away from the main stream of

competition and the pressure of predators, succumbed rapidly to the changes brought by the arrival of man, his ships and his domestic and feral animals.

James Greenway is to be congratulated for the painstaking and careful research which has gone into this volume on extinct and vanishing bird species. It is a highly necessary volume for the library of every serious student of ornithology, as well as a reference for every animal conservationist.—S. DILLON RIPLEY.

The Ornithogeography of the Yucatan Peninsula.—Raymond A. Paynter, Jr. Bull. 9, Peabody Museum of Natural History. 347 pp., pls. 1–4, 1 text-map, 1 folding map. 1955. Price $9.50. The last two decades have seen a tremendous acceleration in interest in Mexican ornithology. The impetus has been provided in large measure by the building of numerous highways and other tributary roads opening up areas of the Republic that previously were almost inaccessible. The present contribution to Mexican ornithology comes, however, not as a result of these modern improvements that expedite travel and exploration but instead as a consequence Paynter's enthusiasm, physical stamina, and willingness to undergo privation and hardships in a country parched by intense tropical heat, lacking in adequate water, and provided in many sections with only the most primitive transportation facilities.

When Paynter selected the Yucatán Peninsula for intensive ornithological study, he chose one of the most critical areas in all Mexico. Not only has there been need for a definitive report on the indigenous birds of the Peninsula, but ornithologists in general, and particularly those in the eastern half of the United States and Canada, have long needed to know more about the status in the Yucatán area of the temperate zone birds that winter there or pass through in migration. The lack of published records from Yucatán of certain presumed trans-Gulf migrants must hinge, in part at least, on the general lack of attention given to North American migrants by early workers, who were more concerned with securing the novel in the avifauna of the Peninsula. Paynter's study does not by any means supply us with all the answers that we seek but it does provide us with specific records from the Yucatán area of no less than 115 winter visitors and twenty-six migrants whose place of birth was in the eastern half of the United States or Canada.

The main text treats each of the 429 species of birds for which Paynter has what he considers thoroughly substantiated records of occurrence on the Peninsula. The author gives the general range and the range on the Peninsula for each species and subspecies, as well as a list of his own specimens followed by sections entitled "Remarks" and "Habitat." The former section includes such items as taxonomic comments, notes on behavior, and discussions dealing with the validity of old records and with anomalies of distribution. When data are available the author includes a section on weights. Of special interest are various introductory chapters that discuss the physiography, geology, climate, and phytogeography of the Peninsula. Paynter divides the Peninsula into three vegetational zones: (1) a narrow belt of "Scrub" on the extreme northern coast, (2) an extensive "Deciduous Forest" occupying the greater part of the Peninsula, and (3) a "Rain Forest" area covering the base and the extreme northeastern corner of the Peninsula. As Paynter himself states, there is no sharp line of demarcation between deciduous forest and what he calls rain forest, but the transition is clinal. Not many students of plants and animals of the American tropics, however, will be willing to go along with Paynter in treating even the wettest part of this cline as anything approaching true rain

forest. The book concludes with an illuminating analysis of the composition, distribution, and origin of the avifauna of the area, with special attention being given to the birds of the islands lying offshore.

Unfortunately one large body of field notes and a fine collection of birds from the Peninsula were not available to Paynter for study in the preparation of this report. Consequently, it is to be hoped that the unpublished material will soon be worked up and any new information that it contains made available for students of Middle American birds.—GEORGE H. LOWERY, JR.

The Travels of William Bartram. Naturalist's Edition.—Edited by Francis Harper. 1958. lxi + 727 pp., 43 ills., maps. Yale Univ. Press, New Haven, Conn. $8.50. William Bartram (1739–1823), a native of Philadelphia, was one of the first naturalists born in North America. His "Travels" through the Carolinas, Georgia and Florida paint a vivid, if perhaps romantic, picture, and were many times reprinted after the original publication in 1791. This new edition includes the original version (with some spelling corrections) and supplies, in addition to a biographical introduction, an informative page by page commentary, an elaborate annotated index identifying localities, plants and animals, a bibliography, and a general index. The original illustrations are reproduced, and as a bonus we are given several other drawings by Bartram and a fine series of landscape photographs showing the country he traversed. Bartram, like his father, was more of a botanist than an ornithologist, but his comments on the behavior and status of various birds and his distributional list of birds from Pennsylvania to Florida demonstrate his observational keenness. The remarkably detailed description (even to iris color) of "*Vultur sacra*" in northern Florida leaves no room for doubt that he had in hand a live bird or freshly killed specimen of the King Vulture (*Sarcoramphus papa*). Bartram's account of the Indians in Florida is especially interesting. For the aborigines (as well as for rattlesnakes) he evinces an admiration and fondness that must have been unusual in a white American of his period.—E. EISENMANN.

A Bird Watcher in Kenya.—Vernon D. van Someren.—1958. 270 pp., 38 photos. Oliver and Boyd, Edinburgh 1, Scotland. 30 shillings.—The name van Someren is a prominent one in the ornithology of East Africa. The present book is the second on the habits of Kenya birds to be published by a member of this family within the last few years. (The other is "Days with Birds," by V. G. L. van Someren, published by the Chicago Museum in 1956.) The present book emphasizes bird photography, is more popular and nostalgic in tone, and was written by Dr. van Someren after he had returned to Scotland. To anyone who has succumbed to the lure of East Africa and its birds, such chapters as those on Mount Kenya or Lake Magadi will bring back fond memories. The text incorporates valuable observations on African birds and general remarks on the African situation and ecology.—DEAN AMADON.

Vertebrates of the United States.—W. Frank Blair, Albert P. Blair, Pierce Brodkorb, Fred R. Cagle and George A. Moore. 1957 ix + 819 pp., many text figs. McGraw-Hill Book Company, New York. $12. Getting into one octave volume keys and diagnoses of all vertebrate species (except marine turtles and fishes) that inhabit the United States is certainly an accomplishment. The book is primarily intended as a text and reference for university courses in classification and natural history. Identification must be made through keys, aided by brief diagnoses of each family, genus, and species. Subspecies are not treated. Illustrations are too

few to do more than assist in understanding the keys, which are, of course, designed to work only for the United States species. As to the diagnoses, the preface states that "each taxon is characterized as it exists on a world-wide basis." This certainly does not hold for many of the passerine families treated. Whatever their practical convenience, some currently recognized bird families blend so smoothly into others (when all included species are considered) that sharp diagnostic lines cannot be drawn—or if they can, their definition is yet to be worked out.

The section on birds was written by Pierce Brodkorb. This is the only work since Ridgway's multi-volume and incomplete "Birds of North and Middle America" that attempts to give the characters on which each North American bird genus is based—a feature giving usefulness to the book even to professional ornithologists. In the main, Brodkorb follows the classification and nomenclature of the A.O.U. Check-list, but he adopts an arrangement much like Tordoff's for the nine-primaried Passeres, sinks a number of currently recognized genera, revives the genus *Baeolophus*, and lumps in one specific unit several allied forms usually treated as species. Some of the changes from current usage have probable merit and all deserve careful consideration. Yet one may question whether it was suitable to adopt them in a book, essentially for non-ornithologists, where the reason for the deviation from the A.O.U. standard could not be discussed adequately and in some instances is not even mentioned.

The bird section is the longest in the book, but has very few illustrations. This might be justified were students referred to some other books on United States birds. By an unfortunate oversight no bibliography of any kind is appended to the ornithological section—although all the other sections include useful lists of references. The lack of diagrammatic illustrations for the characters used in the keys impairs their usefulness. Not even the usual figure depicting the topography of a bird is included. To run down the passerine families, the non-ornithologist must determine the relation of gonys length to width across the mandibular rami, and discriminate between perforate and imperforate nostrils, booted and scutellate tarsi, tenuirostral and conirostral bills. While most of these terms are defined in the glossary, can inexpert students be expected to visualize them without drawings?

Nevertheless the ornithologist will find this book a handy single-volume compendium of the vertebrate groups, and may have occasion to refer to the bird part for brief and well-prepared characterizations of our families, genera and species—even though in the more difficult groups these will not invariably suffice for identification.—E. Eisenmann.

Audubon's Elephant Folio

Our member, W. H. Fries, 86 Cushing Street, Providence 6, Rhode Island, would appreciate information as to the whereabouts of copies of the Elephant Folio of Audubon's "The Birds of America".

Migration

Our Honorary Fellow, Dr. David Lack, Edward Grey Institute of Field Ornithology, Botanic Garden, Oxford, England, is desirous, in connection with a projected work on this subject, to obtain reprints of papers published in the field of migration.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

Anatomy and Embryology

Jollie, M. 1957. Avian anatomy and the anatomist. Condor, **59**: 394–397.—Emphasis is placed upon different interpretations of the same muscle by different anatomists. Individual variation as described in the literature may simply be a matter of differences in interpretation.—D. W. J.

Veselovsky, Z. 1957. Die Schwimmbewegungen der Tauchenten und die anatomische Vergleichung des Gattung *Anas* und *Aythya*. Johann Friedrich Naumann–Ehrung: 56–60. Deutscher Kulturbund, Berlin. Describes (with photographs) the diving and underwater swimming movements of the Pochard (*Aythya ferina*), and compares the anatomy of *Aythya* with that of *Anas* (diagrams).—E. E.

Williamson, F. S. L., and R. A. Norris. 1958. Data on relative heart size of the Warbling Vireo and other passerines from high altitudes. Wilson Bull., **70**: 90–91.—Heart weight relative to body weight for 24 species from mountains of California. *Vireo gilvus* had an unusually high ratio.—J. T. T.

Behavior

Anderson, A. H., and A. Anderson. 1957. Life history of the Cactus Wren. Part I: winter and pre-nesting behavior. Condor, **59**: 274–296.—This represents a twenty-year study of a banded population on a ten-acre suburban plot. In the report are data on the construction and use of roosting nests, song and call notes, territoriality (winter and breeding), and pair-formation.—D. W. J.

Brackbill, H. 1958. Nesting behavior of the Wood Thrush. Wilson Bull., **70**: 70–89.—A detailed description of all phases of the nesting of *Hylocichla mustelina*.—J. T. T.

Castoro, P. L., and A. M. Guhl. 1958. Pairing behavior of pigeons related to aggressiveness and territory. Wilson Bull., **70**: 57–69.—Laboratory experiments with *Columba livia* showed that the most aggressive males competed more successfully in pairing when there were many males to one female. When the sex ratio was about equal, the possession of territories by males enabled all males to pair.—J. T. T.

Ficken, R. W., and M. S. Ficken. 1958. Head-scratching in *Seiurus* (Parulidae) and other passerines. Ibis, **100**: 277–278.—Two Ovenbirds (*S. aurocapillus*) hand-raised from the age of six days by the authors, always scratched directly. Hand-raised Waterthrushes (*S. motacilla* and *noveboracensis*) scratched directly a few times while in the nest, but later scratched indirectly. *Seiurus* seems to be the first example of a genus in which both methods of scratching are seen in the adults. Parulidae joins the Timaliidae as a passerine family with members which scratch directly. Direct scratching in other passerines is reported (Blue Jay and European passerines). The two methods are discussed briefly. A list is given of other captive adult passerines at Cornell University's Laboratory of Ornithology, which scratched indirectly.—J. W. H.

Grimm, H. 1957. Zum Verhalten der Amsel bei abnehmender Tageshelligkeit. Johann Friedrich Naumann–Ehrung: 47–55. Deutscher Kulturbund, Berlin. A statistical study of the effect of varying daylight from March to July on the eve-

ning song of the European Blackbird (*Turdus merula*), including the influence of cloudiness, rain, and wind.—E. E.

HARTSHORNE, C. 1958. Some biological principles applicable to song-behavior. Wilson Bull., **70**: 41–56.—A series of twelve generalizations concerning bird song are made, e.g., limitations determined by structure, amount and quality of song. Numerous examples illustrate the generalizations.—J. T. T.

LATHAM, R. M. 1956. Midwinter courtship flights of woodcock in Delaware. Journ. Wildl. Mgt., **20**: 209.—Reports courtships flights of three male woodcock during January, 1955, in the vicinity of Dover, Delaware; the birds were apparently wintering in the area.—R. F. L.

PETERS, S. S. 1957. Brood capture involving conflict between two female mallards. Wilson Bull., **69**: 363–364.—A female *Anas platyrhynchos*, whose brood of three had flown but who was flightless for an abnormally long time, drove off a second female from the latter's brood of ten and reared nine of them. Another case of brood capture is reported.—J. T. T.

PRESTON, F. W. 1957. The look-out perch as a factor in predation by crows. Wilson Bull., **69**: 368–370.—Observations suggest that *Corvus brachyrhynchos* needs lookout perches for successful predation on ducks and other ground-nesting birds.—J. T. T.

RAND, A. L. 1958. Patterns in the use of left and right limbs in vertebrates. Wilson Bull., **70**: 92–93.—A brief summary of the literature.

ROBINSON, G. 1957. Observations of pair relations of White-headed Woodpeckers in winter. Condor, **59**: 339–340.

SPIERS, D. H. 1957. The notes of the Long-eared Owl. Ont. Field Biologist, **11**: 19–21.

STOTTS, V. D. 1958. The time of formation of pairs in Black Ducks. Maryland Conservationist, **35** (4): 11–15.—Substantial numbers of *Anas rubripes* found to be paired throughout year. Adults apparently pair soon after passing flightless stage. Immature females probably begin to pair (age 3 to 7 months) before immature males.—H. B.

SUMMERS-SMITH, D. 1958. Nest-site selection, pair formation and territory in the House-sparrow, *Passer domesticus*. Ibis, **100**: 190–203.—Sexual dimorphism, sedentary habits, and fixed nest-sites are important factors in the existence of this species. Young House-sparrows become independent 2–4 weeks after leaving the nest. They flock in grassland areas early, and later in grainfields where they are joined by the adults. In October and again in January and February parties of young investigate nest-sites. Juvenal and adult males take up permanent sites soon after the latter period and defend these sites. Egg laying is unusual before April, though mating occurs frequently before this. Once House-sparrows have bred they normally remain faithful to their mates and nest-sites for life. There are exceptions imposed by conditions such as plentiful nest-sites. Pair formation usually occurs, from February through the nesting season and in autumn, by replacement, when one bird of a pair dies. First-year males which do not become paired this way select nest-sites and may attract young females to pair. Although some males never acquire mates, a male which loses its mate has no difficulty getting another. Birds forming pairs late in the season probably are birds from early nestings in the same season. Sex recognition is by plumage. A male in display, postures, shivers, and gives a *chirrup* note. The display is a version of an advertising display of the species. Usually no display is involved in the acquisition of a new mate after a former mate is lost during the season. Bigamy is not

common and not very successful when it occurs. House-sparrows are colonial and each pair defends its nest-site. Because of the faithfulness of pairs to nest-sites, it seems probable that spread of populations to new areas is accomplished by young birds.—J. W. H.

WHITAKER, L. M. 1957. Comments on wing-flashing and its occurrence in Mimidae with uniformly colored wings. Wilson Bull., **69**: 361–363.—"Wing-flashing" needs to be defined more exactly because some descriptions do not make clear whether the behavior is similar to that of *Mimus polyglottos*.—J. T. T.

WILLIAMS, F. M. 1958. Interspecific defense of roost site by Loggerhead Shrike. Wilson Bull., **70**: 95–96.—*Lanius ludovicianus* drove away all birds which entered its roosting tree in the day.—J. T. T.

Diseases and Parasites

CARRIKER, M. A., JR. 1957. Neotropical miscellany No. 11. A new species and subspecies of *Ardeiphagus* from Colombia. Novedades Colombianas, **3**: 163–166. New forms of Ischnocera (bird-lice) found on the tiger-herons *Tigrisoma salmoni* and *T. l. lineatum*. *Ardeiphagus* has hitherto been reported only from the Boat-billed Heron (*Cochlearius*).—E. E.

O'MEARA, D. C. 1956. Blood parasites of some Maine waterfowl. Journ. Wildl. Mgt., **20**: 207–209.—Reports incidence of blood parasites among a large sample of wild ducks in Maine; the blood smears were taken mainly from ducks caught in banding traps during the summers of 1945, 1946, and 1953. Three groups of blood parasites were found: *Leucocytozoon* spp., *Haemoproteus* spp., and *Microfilaria* spp. Combined infections involving all possible groupings of the three parasites were recorded. Among 437 black ducks and 499 wood ducks the incidence of single infection was 76.0 and 52.1 per cent *Leucocytozoon*, 28.8 and 23.6 per cent *Microfilaria*, and 9.8 and 56.9 per cent *Haemoproteus*, respectively; 16.9 per cent of the black ducks and 12.4 per cent of the wood ducks were not infected. A difference in the incidence of parasitism was recorded from different ecological areas. New hosts (ducks) for the blood parasites are also reported.—R. F. L.

Distribution and Annotated Lists

BAILLIE, J. L. 1957. Recent additions to Ontario's bird list. Ont. Field Biologist, **11**: 1–3.

BAILLIE, J. L. 1958. Six old yet new Ontario breeding birds. Ont. Field Biologist, **12**: 1–7.—Breeding records for Redhead, Golden Eagle, Sandhill Crane, Forster's Tern, Rock Dove, and Fox Sparrow.—F. M.

BASILIO, A. 1957. Caza y Pesca en Annobón. Aves de la Isla. La Pesca de la Ballena. 1–98. Instituto de Estudios Africanos (Cosejo Superior de Investigaciones Cientificas), Madrid, Spain. 45 pesetas. The first 64 pages of this booklet are devoted to the birds of Annobón, an island in the Gulf of Guinea, just south of the Equator. 22 species are listed, many of them passage migrants. There is some information on breeding season and behavior.—E. E.

BEHLE, W. H. 1958. The birds of the Raft River Mountains, northwestern Utah. Univ. of Utah Biol. Series, **11**, 6, 40 pp.—The third paper of a series dealing with the avifauna of western Utah. Introductory sections describe the region and its ecologic formations, and comparisons are made with avifauna of adjacent areas. 172 kinds (species and subspecies) of birds are known from the region. The systematic list gives information on status and habitat and in many cases subspecific relationships are considered in detail.—F. M.

BLAKE, E. R. 1958. Birds of Volcán de Chiriquí, Panama. Fieldiana, Zool., **36**, no. 5: 499–577.—A report of a collection of 1611 birds by Señor Tolef B. Mönniche, made over a period of twenty years, containing detailed taxonomic, distributional and ecological notes, and dates of arrival and departure of migrants. Almost all specimens were taken on the Pacific slope at elevations between about 5,000 and 10,500 feet, a few on the Caribbean side of the continental divide. 235 forms are reported.—M. A. T.

FELTEN, H. and J. STEINBACHER. 1955. Zur Vogelfauna von El Salvador. Senck. Biol., **36** (1/2): 9–20. Forschungs-Institut Senckenberg, Frankfort am Main, Germany. Report of a collection of 199 specimens, 84 forms, taken in El Salvador.—E. E.

FELTEN, H. and J. STEINBACHER. 1955. Contribuciones al conocimiento de la avifauna de El Salvador. Comun. Inst. Trop. Cient., **4** (1/2): 1–36. Univ. de El Salvador, San Salvador, El Salvador. Report on the same collection mentioned above, but with additional notes on ecology, behavior, molt condition, weights and stomach contents.—E. E.

FOSTER, J. B. 1957. Snow and Blue Geese nesting in the southern arctic. Ont. Field Biologist, **11**: 22.—Reports nesting near Eskimo Point, at Cape Henrietta Maria, and near Churchill.—F. M.

KUX, Z., S. SVOBODA and K. HUDEC. 1955. Vezeichnis der Avifauna Mährens. Acta Musei Moraviae, **40**: 156–219. 12 photos. Annotated check-list of the birds of Moravia, Czechoslovakia. (In Czech and German; Russian summary.) 333 species are listed from Moravia (356 known from all Czechoslovakia); 184 are known to breed (210 in all Czechoslovakia), including four introduced game birds, among them the Turkey, now almost extirpated.—E. E.

LAMM, D. W., and M. T. HORWOOD. 1958. Species recently added to the list of Ghana birds. Ibis, **100**: 175–178.—This paper reports ten additional species not previously known from Ghana, according to Bannerman's "The Birds of Tropical West Africa" (1930–51). Species include *Pseudogyps africanus, Porzana marginalis, Ortyxelos meiffrenii, Sterna f. fuscata, Otus s. scops, Pachycoccyx v. validus, Anthus cervinus, Cisticola emini admiralis, Lamprocolius splendidus chrysonotis,* and *Hypochera ultramarina neumanni.* An additional form, *Xanthophilus a. aurantius* was previously but erroneously reported, and is here definitely established as a breeding bird of Ghana.—J. W. H.

MAKATSCH, W. 1958. Ornithologische Beobachtungen zwischen Euphrat und Tigris. Vogelwelt, **79** (1): 1–8. Observations in Irak. (In German.)

MUNSON, H. A. 1958. Winter record of Grasshopper Sparrow in Columbia County. Kingbird, **8** (2): 42. Specimen taken Jan. 16, 1958 in eastern New York.

NORTON, W. J. E. 1958. Notes on birds in the Elburz Mountains of north Persia. Ibis, **100**: 179–189.—Observational data are given on 42 species, the status of which seemed to differ from that reported in the literature by Stresemann, Meiklejohn, *et al.* An additional 24 species were recorded. The area is briefly described.—J. W. H.

OLROG, C. C. 1956. Un aguila nueva para la Argentina. Hornero, **10** (2): 172–173. First record of *Oroaëtus isidori* from Argentina.—E. E.

OLROG, C. C. 1956. Contenidos estomacales de aves del noroeste argentino. Hornero, **10** (2): 158–163. Stomach contents of certain birds from northeastern Argentina.—E. E.

PARTRIDGE, W. H. 1956. Un nuevo dormilón para la fauna de Argentina y Para-

guay. Hornero, **10** (2): 169–170. Four specimens from Misiones, Argentina, and one from Paraguay identified as *Caprimulgus serico-caudatis* (Cassin), a nightjar of uncertain origin, according to Peters' "Check-list of Birds of the World." Differences in both sexes between this species and *C. rufus*, with which it has been confused, are stated. The reviewer has been informed by J. Bond *(in litt.)* that the original and correct spelling used by Cassin was *"serico-caudatus,"* not *"-is,"* as spelled in Peters' work, and that specimens are known from southern Brazil.—E. E.

ROOT, O. M. 1958. The birds of the Andover region. Reprinted from Bull. Mass. Aud. Soc., **41**, no. 9: **42**, nos. 1, 2, 3, 1957–58, 38 pp.—An account of the occurrence and distribution of birds in the Andover region, which lies in the western part of Essex County in northeastern Massachusetts. Short sections deal with topography, climate, good bird areas, changes in status, and summaries of Christmas and Breeding-bird counts. The paper results from a study over sixteen years, 1942-1957.—F. M.

SIMPSON, J. M., and J. R. WERNER. 1958. Some recent bird records from the Salt River Valley, central Arizona. Condor, **60**: 68–70.

STEINBACHER, J. 1956. Uber eine kleine Vogelsammlung aus El Salvador. Senck. Biol., **37** (5/6): 371–375. Forschungs-Institut Senckenberg, Frankfurt am Main, Germany. A collection of 18 forms, some northern migrants, from El Salvador.—E. E.

TRAYLOR, M. A. 1958. Birds of northeastern Peru. Fieldiana, Zool., **35**, no. 5: 87–141.—A collection of 807 specimens, chiefly from lowland localities along the Ucayali River, Department of Loreto (236 species), with some from the subtropical zone on the divide between the Ucayali and Huallaga Rivers in Huanuco (69 species). Only four forms collected were common to both zones. Reported as new to Peru: *Spizastur melanoleucus, Geranospiza c. caerulescens, Piculus chrysochlorus laemostictus, Celeus spectabilis, Conopias trivirgata berlepschi, Caprimulgus s. serico-caudatus, Sporophila americana.* Useful taxonomic comments on many species.—E. E.

VAURIE, C. 1957. Field notes on some Cuban birds. Wilson Bull., **69**: 301–313. —On 33 species of the western tip of Cuba. Methods of catching birds for cage birds are described.—J. T. T.

WALKINSHAW, L. H., and M. A. WOLF. 1957. Distribution of the Palm Warbler and its status in Michigan. Wilson Bull., **69**: 338–351.—The first reported nestings of *Dendroica palmarum palmarum* in Michigan are described, along with the habitat, nest site, and nest.—J. T. T.

ZASTROV, M. 1957. Ornithologische Mitteilungen aus Ellarnaa. Ann. Soc. Tartuensis Res. Nat. Invest. Const. (Ser. nov. in exsilio condita), Lund, **1**: 88–104, 5 figs. (In German).—List of 98 species with brief discussion of habitat.

ECOLOGY AND POPULATION

BALOGH, J. 1958. Lebensgemeinschaften der Landtiere. Hungarian Academy of Sciences, Budapest: 1–560.—This textbook of ecology with particular reference to terrestrial animals emphasizes the community point-of-view. There is an analysis of the internal structure and dynamics of the community, succession, and classification of different types. Concepts of dominance and productivity are given special attention. Nearly half of the book is concerned, however, with methods of collecting and measuring invertebrate animal populations. It is here that the author makes his greatest contribution. The section on birds and mammals is

written by F. J. Turcek of Czechoslovakia. Berndt Heydemann prepared a section on methods of studying communities in man-made habitats. Some 800 citations of literature are listed, approximately equally divided between German and English with a scattering of other languages.—S. C. K.

BERGER, A. J. 1957. Population density of Alder Flycatchers and Common Goldfinches in *Crataegus* habitats of southeastern Michigan. Wilson Bull., **69**: 317–322.—Data are presented on the nesting of *Empidonax traillii* and *Spinus tristis* in a habitat primarily of shrubby *Crataegus* scattered among herbaceous vegetation. Discussed are nesting density, nest height above ground, nesting success, and other related subjects.—J. T. T.

BURTON, D. E. (Editor). Winter bird and breeding bird population studies. Ont. Field Biologist, **11**: 11–16.—The results of a breeding population study in 1956 (in one area) and winter population studies in 1956–57 (in four localities), all in the Toronto area.—F. M.

DAVIS, J., and L. WILLIAMS. 1957. Irruptions of the Clark Nutcracker in California. Condor, **59**: 297–307.—Fall and winter invasions by *Nucifraga columbiana* into the lowlands of California are discussed and correlations are made with food supply and population size. In California the invasions correlate best with food shortage facing an unusually large population of birds.—D. W. J.

GOODHART, C. B. 1958. Thrush predation on the snail, *Cepaea hortensis*. Journ. Animal Ecol., **27** (1): 47–57.—The snail is eaten in numbers by *Turdus ericetorum* during June-July and again during Jan.-Mar. when other food is scarce. More pink than yellow shells are taken but there is no differential predation of the various shell banding patterns.—S. C. K.

GOODWIN, C. E. 1956. Black duck and Mallard populations in the Toronto area. Ont. Field Biologist, **10**: 7–18.—In 1931, tame mallards and black ducks were released in Toronto and established themselves on a resident semi-wild basis. These birds have hybridized fairly freely, but mallards have increased rapidly in proportion to black ducks. The author reports what is known of this interesting situation, speculates on the factors which might be influencing the population and suggests some of the problems which should be investigated.—F. M.

LEPIKSAAR, J. 1957. Feldornithologische Reminiszenzen aus Estland (Methodik und Biotope). Ann. Soc. Tartuensis Res. Nat. Invest. Const. (Ser. nov. in exsilio condita), Lund, **1**: 65–87, 1 fig. (In German).—Detailed outline of biotopes, with brief notes on birds.

MACNAB, J. A. 1958. Biotic aspection in the Coast Range Mountains of northwestern Oregon. Ecol. Mono., **28**: 21–54.—Description of a new classification of seasonal aspects in ecological communities, useful also in bird studies.—S. C. K.

MCCLURE, H. E. 1957. A study of summer bird populations near Tokyo, Japan. Wilson Bull., **69**: 323–332.—Twelve species were regularly recorded in a 100-acre plot of upland farms and farmyards. Population changes are described and discussed.—J. T. T.

ORIANS, G. H. 1958. A capture-recapture analysis of a shearwater population (with a statistical appendix by P. H. Leslie). Jour. Animal Ecol., **27**: 71–86.—Recoveries of *Procellaria puffinus* banded as nestlings show that most of them do not return to the nesting colony until they are 3–4 years old. Survival rate indicated by banding adults is 50–80 per cent, but other considerations make it probable that it is over 90 per cent per year. A method of testing whether banded birds were being sampled at random is described.—S. C. K.

SALT, G. W. 1957. An analysis of avifaunas in the Teton Mountains and Jackson

Hole, Wyoming. Condor, 59: 375–393.—In continuing his studies of ecologic analyses of avifaunas, Dr. Salt has calculated standing crop biomasses for each avifauna and category therein. Comparisons are made with avifaunas from other parts of the country. The author suggests that proper analyses of avifaunas may be used as indices of metabolism and efficiency of the biotic community.—D. W. J.

UDVARDY, M. D. F. 1958. Ecological and distributional analysis of North American birds. Condor, 60: 50–66.—Here is another attempt to analyze in a major fashion the avifauna of North America and to compare it with European avifauna. This is accomplished by selecting ten ecological groups, roughly equivalent to biomes, and by tabulating species and genera common to both continents. In the final analysis the author concludes that passerines of the two continents are much less related than nonpasserines, and considerable discussion is devoted to possible origins of the various avifaunal elements.—D. W. J.

WILLIAMS, G. R. 1957. Some preliminary data on the population dynamics of the Takahe (*Notornis mantelli*, Owen). Notornis, 7: 165–171.—The breeding season extends from early October to the end of March. Breeding may occur during the first season after hatching; at least some birds breed annually. Clutch-size 1 or 2 eggs. At least 66 per cent fertility recorded in 35 eggs; 29 per cent of eggs laid gave rise to chicks which left the nest. Comparisons are drawn with published data on other Rallidae. Evidence bearing on the replacement rate and population regulation is discussed. It is thought that the species must be long-lived.—F. M.

WILLIAMSON, F. S. L. 1957. Ecological distribution of birds in the Napaskiak Area of the Kuskokwim River Delta, Alaska. Condor, 59: 317–338.—This is a very significant analysis of avian distribution in a little-known area. The author thoughtfully categorizes ten ecological formations on the basis of life form of the vegetation, and indicates the species which show preferences for each formation. There follows an annotated list of some 62 species in which there are scattered details, as available, on weights, gonad size, nests, ages, and habitat choices.—D. W. J.

General Biology

BURTON, D. E. 1958. Nesting of the Cedar Waxwing in southern Ontario. Ont. Field Biologist, 12: 19–22.—Observations on 41 nests of *Bombycilla cedrorum* show that July and August are the peak nesting months. 33 nests were in hawthorns, and averaged 7 feet from the ground. Early nests are occasionally parasitized by the Cowbird.—F. M.

CHRISTENSEN, H. O. 1958. [Observations on the breeding biology of the Red Crossbill (*Loxia curvirostra* L.)]. Dansk. Ornith. For. Tids., 51 (4): 168–175. (In Danish: English summary.)

KLIMSTRA, W. D., and W. O. STIEGLITZ. 1957. Notes on reproductive activities of robins in Iowa and Illinois. Wilson Bull., 69: 333–337.—Nest location and construction by *Turdus migratorius*, clutch size, incubation, and success.—J. T. T.

LACK, D. 1958. The significance of the color of turdine eggs. Ibis, 100: 145–166.—Employing information from published works, scientific collections, and personal observations, the author summarizes in table and discussion form information on nest-sites and color of eggs of members of the subfamily Turdinae for which such data are available. It is concluded that egg color as a taxonomic guide is generally unreliable, and that there is a general correlation between type of nest-site and egg color (white eggs in cavities, drab eggs on the ground in

herbage or on ledges, speckled eggs or immaculate blue eggs in shallow holes or niches, forks of trees or bushes, or in domed nests). It is concluded further that white eggs in cavities are an adaptation for increased visibility to parents rather than to absence of predators, and that eggs of small passerines are not warningly colored.—J. W. H.

MAYHEW, W. W. 1958. The biology of the Cliff Swallow in California. Condor, **60**: 7–37.—This is a major contribution to the biology of this species, conducted over an eight-year period, and involving 18,004 banded swallows in California. Significant data are presented for habitat requirements, arrival of birds, pair formation, vagrancy and homing, nest construction, egg-laying, incubation, brooding, and return of banded birds. One is impressed by the extensive work involved in amassing these data, especially techniques of trapping and banding.—D. W. J.

MYRES, M. T. 1957. Clutch size and laying dates in Cliff Swallow colonies. Condor, **59**: 311–316.

MYRES, M. T., I. MCT. COWAN, and M. D. F. UDVARDY. 1957. The British Columbia nest records scheme. Condor, **59**: 308–310.—A cooperative scheme for amassing nest data is outlined, with the principal objective being a central repository for standardized complete nesting data.—D. W. J.

SAGE, B. L. 1957. Remarks on the taxonomy, history and distribution of the House Sparrow into Australia. Emu, 57 (5): 349–352.—Five specimens with wing measuring 71–73 mm.; said to be considerably smaller than European average. *Passer domesticus*, introduced less than a century ago, now breeds in Australia September–December, though derived from European birds breeding in the northern hemisphere spring.—E. E.

SELANDER, R. K., and J. K. BAKER. 1957. The Cave Swallow in Texas. Condor, **59**: 345–363.—This paper summarizes extant data on *Petrochelidon fulva* in Texas, with information on breeding colonies in limestone caves, distribution in the state, annual cycle, nest construction, taxonomy, and vocalizations. It is of considerable interest to note how the authors combine field and laboratory techniques in order to evaluate these life history data.—D. W. J.

SHARLAND, M. 1957. Egrets at Ulmarra, N. S. W. Emu, **57** (5): 296–302.—Colonies of *Egretta alba*, *Bubulcus ibis*, and other species nesting in New South Wales, Australia.

SKUTCH, A. F. 1958. Life history of the Violet-headed Hummingbird. Wilson Bull., **70**: 5–19, with a color plate by D. R. Eckelberry.—*Klais guimeti*, of Central and northern South America, is briefly described, as are its habitats, the singing assemblies of males, nest, and nesting behavior.—J. T. T.

SKUTCH, A. F. 1958. Life history of the White-whiskered Soft-wing, *Malacoptila panamensis*. Ibis, **100**: 209–231.—Based on observations of six nests of this puffbird, family Bucconidae, the author presents life-history information under the following headings: Appearance and General Habits; Voice; The Nest; The Eggs; Incubation; The Nestlings. The nestlings are habitually silent and after nocturnal brooding ceases, nightly raise up leaves from the floor to form a screen in front of themselves. This paper is an important addition to Skutch's already large list of contributions on tropical American birds.—J. W. H.

TAYLOR, R. R. 1958. Observations on a Black-backed Three-toed Woodpecker's nest. Ont. Field Biologist, **12**: 7–9.—Includes a description of the nest and the plumage of the nestlings.—F. M.

THOMAS, H. F. 1957. The Starling in Sunraysia District of Victoria. Emu, **57** (5): 325–337.—*Sturnus vulgaris*, introduced into Australia from Europe, now has its

breeding peak in September, October, November. Clutch is usually four or five; broods are sometimes two. No birds with really swollen gonads were found before August.

VERHEYEN, R. 1957. Contribution à la biologie du Coucou Cuivré, *Chrysococcyx caprius* (Bodd.). Gerfaut, **47**: 259–264. Observations of the parasitic Didric Cuckoo in the Belgian Congo. A marked male was apparently mated to two females. There is evidence of territorialism. (In French.)—E. E.

VESEY-FITZGERALD, D. F. 1958. Notes on breeding colonies of the Red-billed Quelea in S. W. Tanganyika. Ibis, **100**: 167–174.—The nesting and food habits of a flock of the Red-billed Quelea (*Q. quelea*) in the Rukwa Valley are discussed. One colony, established after heavy rains in the area, was estimated to consist of two and one-half million pairs occupying an area of grassland of 93 acres, a density of five nests per square yard. Incubation was principally at night. The average clutch size was three eggs. Incubation apparently is by the female alone. Nesting was very successful; no predators were recorded. Diurnal activity was marked by early morning flights to feeding grounds by flocks. Numerous birds remained in the colony at these times, defending their individual nest-sites. Many birds in the colony were juveniles indicating an earlier nesting that year. Five male plumage phases were evident among the members of the colony. Rukwa birds seem to belong to the race *centralis*. Food consisted primarily of grass seeds and insects.—J. W. H.

MANAGEMENT AND CONSERVATION

BAILEY, R. W. 1956. Sex determination of adult wild turkeys by means of dropping configuration. Journ. Wildl. Mgt., **20**: 220.—The author concludes that the sex of adult wild turkeys, *Meleagris gallopavo silvestris* Vieillot, can be determined by the size and shape of their respective droppings. Droppings of adult gobblers are straighter, longer, and greater in diameter (about 10–15 mm.) than are those of hens. Droppings of hens are characterized by their smaller diameter (5–8 mm.) and their short looped, spiral, or bulbous shape.—R. F. L.

MCINTYRE, J. D. 1957. Predation on Leach's Petrel on eastern Canadian bird islands. Ont. Field Biologist, **11**: 4–6.—Unless the number of foxes is reduced, the future of the Leach's Petrel colony on Bonaventure Island may well be imperilled.—F. M.

ROSENE, W., JR., and F. W. FITCH, JR. 1956. A comparative test of the investigator as a variable in aging quail. Journ. Wildl. Mgt., **20**: 205–207.—To test the reliability of current aging techniques (wing molt criteria) for bobwhite quail, five biologists made age determinations from 200 quail wings selected randomly from many wings collected in Alabama during the 1952–53 hunting season. The results of this test showed that a difference of 3.5 per cent (classification varied from 26.0–29.5 per cent for adults and 70.5–74.0 per cent for juveniles) occurred between investigators in their classification of age groups. Authors emphasize the need for investigators to be fully familiar with the aging techniques and their existing weaknesses.—R. F. L.

SNYDER, L. L. 1958. Collecting birds and conservation. Ont. Field Biologist, **12**: 16–18.

SOWLS, L. K., and L. A. GREENWALT. 1956. Large traps for catching quail. Journ. Wildl. Mgt., **20**: 215–216.—Describes the increase in trapping efficiency obtained by using large traps (mainly 3 x 3 x 6 feet), rather than the standard quail traps (1 x 3 x 3 feet), for capturing Gambel's Quail, *Lophortyx gambeli* and

Scaled Quail, *Callipepla squamata*. The average catch from 125 small traps and 355 large traps was 4.7 and 9.0 birds per set, respectively.—R. F. L.

THIESSEN, G. J., E. A. G. SHAW, R. D. HARRIS, J. B. GOLLOP, and H. R. WEBSTER. 1957. Acoustic irritation threshold of Peking Ducks and other domestic and wild fowl. Journ. Acoustical Soc. of Amer., **29**: 1301–1306.—Experiments with a siren established that Peking ducks respond to sounds of an intensity greater than about 70 db by frequent head shaking, tail twitching and opening of the mouth. Hungry ducks were discouraged from taking food in a low-frequency sound field at 100 db intensity. Experiments carried out in September 1952 on wild Mallards in Saskatchewan were successful in greatly reducing the number of ducks using three sloughs. Siren blasts of 2–4 mins. for a total of about 20 mins. on two successive days cleared an area for the following 48 hours. Tests on Alberta Pintails were less successful and the birds returned to the area within a day, while further tests in Saskatchewan in 1953 were unsuccessful. It is concluded that "with the equipment at present available the protection of crops from mallard and pintail ducks by the use of high-intensity sound is not an economical proposition."—F. M.

VERHEYEN, R. 1958. [On the average age of the Blackbird (*Turdus merula* L.).] Gerfaut, **48** (1): 5–14. Belgian banded individuals when recovered averaged 336 days (11 months) old. Contrary to Lack's English data, Verheyen found no indication that Belgian young birds were more vulnerable than adults. According to his data at the beginning of the nesting season the population consists 34% of older birds and 66% of first year birds. Of the latter 33% survive to the next breeding season, and of the survivors 34% attain the following season. One bird carried a band for over 7 years. (In Flemish; French summary.)—E. E.

WESTFALL, C. Z., and R. B. WEEDEN. 1956. Plastic neck markers for woodcock. Journ. Wildl. Mgt., **20**: 218–219.—Describes the use of a plastic "neck-bow" for marking woodcock. The 3 x ¾-inch tag is constructed from 20-gauge upholstery plastic, and is attached to the bird's neck with a surgical clip. Markers should be depended upon *only* for short-term studies.—R. F. L.

MIGRATION AND ORIENTATION

BELLROSE, F. C. 1958. The orientation of displaced waterfowl in migration. Wilson Bull., **70**: 20–40.—Juvenal Blue-winged Teal (*Anas discors*), held captive in Illinois until after the autumn migration period, were found to migrate in the direction normal for the species. This is thought to be an example of Griffin's type II orientation; the birds were "able to fly in a certain direction even when crossing unfamiliar territory." Mallards (*Anas platyrhynchos*) displaced from Illinois to Utah remained near the release point for the rest of the season, but in subsequent seasons two-thirds of the adults returned to the Mississippi Flyway while two-thirds of the juveniles remained in the Pacific Flyway. Young female Wood Duck (*Aix sponsa*) homed to the area they inhabited just before the fall migration, but transplanted ducklings did not return to their natal home.—F. M.

BURTON, D. E. 1957. The fall migration of Blue Jays at Toronto, Ontario. Ont. Field Biologist, **11**: 7–10.—The Blue Jay has increased in southern Ontario during the past 25 years. A marked movement to the west was observed through the city of Toronto, with peak flights between September 20th and 25th from 1952 to 1955. On September 23, 1954, 2,733 were counted between 7:30 and 10:30 a.m. Flights start early in the morning and are usually over by noon. When the wind is strong the birds fly lower.—F. M.

JOHNSTON, D. W. 1957. Bird mortality in Georgia, 1957. Oriole, **22**: 33–39.

KENYON, K. W., and D. W. RICE. 1958. Homing of Laysan Albatrosses. Condor, **60**: 3–6.—Fourteen out of eighteen adult albatrosses removed from nests at Midway Atoll returned to their nests from widely-spaced points of release. The greatest distance covered was 4120 miles in 32 days, whereas another bird returned 3200 miles in about 10 days, thus averaging 317 miles per day.—D. W. J.

LINCOLA, P. 1958. [Recoveries of birds ringed at Signilskär indicating the speed of migration.] Orn. Fen., **35** (2–3): 125–126, 127. A list of 12 species (37 individuals) recovered within two months of banding in Finland, with dates and average distance travelled per day. Included are *Falco columbarius, Accipiter gentilis, A. nisus,* and *Loxia curvirostra.* (In Finnish; English summary.)

MACDONALD, J. D., and B. P. HALL. 1957. Ornithological results of the Bernard Carp/Transvaal Museum Expedition to the Kaokoveld, 1951. Annals Transvaal Museum, **23**: 1–39.—A report on a collection totalling 778 specimens of 140 species made in a little known area of South West Africa. A number of birds still rare in collections and poorly understood are included and the notes on them contribute to their elucidation. The collection was sent to the British Museum to be studied in connection with the material gathered by the British Museum South West Africa Expedition of 1949–50, as the field work of the present expedition was planned to supplement rather than to duplicate that of the other one.—H. F.

MACKAY, R. H. 1957. Movements of the Trumpeter Swans shown by band returns and observations. Condor, **59**: 339.—Birds banded in the Peace River District of Alberta spent the winter on the Red Rock Lakes Refuge in Montana. —D. W. J.

PHILLIPS, W. W. A. 1958. Terns (*Chlidonias leucopterus* and *Sterna macrura*) and other birds in mid-Atlantic in late April. Ibis, **100**: 276–277.

STEVENS, O. A. 1957. Fall migration and weather, with special reference to Harris' Sparrow. Wilson Bull., **69**: 352–359.—Banding records of 7000 *Zonotrichia querula* showed that southward flights were not well correlated with weather, but seemed to come near certain dates.—J. T. T.

STONEHOUSE, B. 1958. Notes on the ringing and breeding distribution of the Giant Petrel, *Macronectes giganteus.* Ibis, **100**: 204–208.—Recoveries from about 800 banded chicks in Chile, South Africa, Australia, and New Zealand, suggest that young birds in their first and second years of life disperse northward and eastward on leaving their nesting grounds in the South Orkney Islands. The eastward movement may be due to effects of a zone of westerly winds. Rate of travel, distance covered and range of wanderings is discussed. The existence of a colony below the Antarctic Circle is reported.—J. W. H.

VLEUGEL, V. A. and W. VON WESTERNHAGEN. 1958. Formen des Zugen in abweichender Richtung unter den Einfluss geographischen Faktoren. Dansk. Ornith. For. Tids., **51** (4): 176–190.—Deflected migration under the influence of geographical factors. A general review of directional lines and reverse migration. (In German; Danish summary.)

PHYSIOLOGY

FISHER, H. I., and L. M. BARTLETT. 1957. Diurnal cycles in liver weights in birds. Condor, **59**: 364–372.—Decreases in liver weights overnight are attributed primarily to decrease in fat content, which subsequently rises during the day, along with glycogen content, to a maximum in early evening. It is suggested that "as

spring comes on, a smaller amount of stored food from the liver is necessary to supply the metabolic needs of the roosting bird."—D. W. J.

PITELKA, F. A. 1958. Timing of molt in Steller Jays of the Queen Charlotte Islands, British Columbia. Condor, **60**: 38-49.—Among other conclusions reached in this study is the fact that the timing of molt is as closely linked with abundance of summer food as is the period of breeding.—D. W. J.

TOMLINSON, J. T., and R. S. MCKINNON. 1957. Pigeon wing-beats synchronized with breathing. Condor, **59**: 401.

TAXONOMY AND PALAEONTOLOGY

BAUER, K. 1957. Zur systematischen Stellung des Blutspechtes. Johann Friedrich Naumann—Ehrung: 22-25. Deutscher Kulturbund, Berlin. The Syrian Woodpecker (*Dendrocopos syriacus*) in spreading into central Europe has hybridized with the Great Spotted Woodpecker (*D. major*). The view is expressed that *D. syriacus* is a good species, for hybridization occurs only in the early stage of the invasion when numbers are so few that difficulty exists in finding conspecific mates. The vocalizations of *syriacus* are said to resemble those of *D. medius* more than *D. major*.—E. E.

COTTER, W. B., JR. 1957. A serological analysis of some Anatid classifications. Wilson Bull., **69**: 291-300.—The methods used in testing antigen reactions are described in detail. The Muscovy Duck (*Cairina*) is closely related to the Wood and Mandarin Ducks (*Aix*), distantly related to *Anas*, and still more distantly to *Anser*.—J .T. T.

DAWSON, E. W. 1958. Re-discoveries of the New Zealand subfossil birds named by H. O. Forbes. Ibis, **100**: 232-237.—H. O. Forbes described between 1890 and 1893 a number of new species of subfossil birds from the New Zealand Quaternary. The material upon which these descriptions were based, long thought lost, has been re-discovered in the British Museum. Examination of this material suggests that a number of taxonomic and nomenclatural changes are in order.—J. W. H.

LEHMANN, F. C. 1957. Contribuciones al Estudio de la Fauna de Colombia XII. Novedades Colombianas, Contr. Cient. Mus. Hist. Nat. Univ. del Cauca, Popayan, Colombia, no. **3**: 101-156. (In Spanish.)—*Cathartes burrovianus dugandi* and *Tangara schrankii anchicayae* described as new.

MOREAU, R. E. 1958. Some aspects of the Musophagidae. Ibis, **100**: 67-119; 238-270.—A revised classification of the turacos is presented. Eighteen species in five genera are recognized. *Gymnoschizorhis* is sunk in *Corythaixoides* and *Ruwenzorornis*, *Proturacus* and *Gallirex* in *Tauraco*. *Tauraco corythaix* provisionally is considered polytypic including *persa* and *fischeri*. The author closely describes the geographic and ecologic ranges of each species, including a cogent discussion of the factors involved in the complexities of these distributional patterns. Subspecific variation is described. The third part of the paper is arranged under the following headings: Melanins; Gloss; Turacin and Turacoverdin; Size and proportions; Beaks and nostrils; Head ornamentation; Voice; Habitat and overlap; Points of Musophagid geography; Some problems of musophagid variation. Turacoverdin, like turacin, is mainly a copper complex. Turacin is soluble only in alkali and is therefore not likely to be washed out of the plumage under natural conditions. It is shown that copper as a trace element in soils and foods is sufficiently prevalent to account for the copper in these birds' plumages. Interesting "musings" by the author under the headings from "Size and proportions"

through "Some problems in musophagid variation" provide food for thought, but he simultaneously and logically arrives at few conclusions — evidence of the primitive state of our knowledge of the biology of Touracos.—J. W. H.

VERHEYEN, R. 1957. Analyse du potentiel morphologique et projet de classification des Columbiformes (Wetmore 1934). Bull. Inst. R. Sci. Nat. Belgique, **33**, no. 3:1–42. A proposed classification of the pigeons, based on comparison of a long list of characters (anatomical, physiological, ethological, as well as those of external morphology). The author opposes current lumping tendencies and recognizes 8 subfamilies and 13 tribes of Columbidae; he breaks up the genus *Columba* by reviving the genera recognized by Ridgway for the American species. The sandgrouse, Pteroclididae, he removes from the Columbiformes and places in a new order Turniciformes (including also Turnicidae and Thinocorythidae).—E. E.

VERHEYEN, R. 1957. Contribution au démembrement de l'ordo artificiel des Gruiformes (Peters 1934). I Les Ralliformes. II Les Cariamiformes. III Les Jacaniformes. Bull. Inst. R. Sci. Nat. Belgique, **33**, nos. 21: 44, 39: 1–7, 48: 1–19. In these three papers the order Gruiformes is divided into three new orders: Ralliformes, including Otidae, Psophiidae, Gruidae, Aramidae, Rallidae, and Heliornithidae; Cariamiformes, including Cariamidae and *Sagitarius* (removed from Falconiformes), given subordinal rank; and Jacaniformes, including Jacanidae (removed from Charadriiformes), Eurypygidae, and Rhynochetidae, each with subordinal rank.—E. E.

VERHEYEN, R. 1958. Analyse due potentiel morphologique et projet d'une nouvelle classification des Charadriiformes. Bull. Inst. R. Sci. Nat. Belgique, **34**, no. 18: 1–35. A new classification of the Charadriiformes. The gulls, alcids and jacanas are removed; the suborder Charadrii is divided into four families, Haematopidae (including the Recurvirostrinae as well as the oystercatchers), Charadriidae, Phalaropidae, Scolopacidae (restricted to snipes and woodcocks), Tringidae (including *Limnodromus*, the Arenariinae, and the waders placed by Peters in Tringinae and Eroliinae). The sheathbills, *Chionis*, are given subordinal rank.—E. E.

MISCELLANEOUS

KUMERLOEVE, H. 1957. Der Vogelmord in Italien. Kosmos, **53**, (5): 221–226, photos. (In German).—Netting of thousands of small birds for sale as food in the markets.

PRESTWICH, A. A. "I name this parrot . . ." 1958. 86 pp. Price 5/6. A. A. Prestwich, 61 Chase Road, Oakwood, London, N. 14. A list of parrots bearing dedication names, giving brief biographical accounts of the persons after whom they were named.

SCHORGER, A. W. 1957. The contributions of Josselyn Van Tyne to the Wilson Ornithological Society. Wilson Bull., **69**: 314–316.

WADE, D. E. 1957. Tape-recording the American Woodcock. Chat, **21**: 73–78.

CONTRIBUTORS TO RECENT LITERATURE

The short reviews in the Recent Literature section of 'The Auk,' vol. 75, were contributed by the following persons (their identity being indicated in most instances by initials): G. A. Bartholomew, A. J. Berger, S. T. Dillon, E. Eisenmann, R. F. Johnston, S. C. Kendeigh, R. F. Labisky, W. E. Lanyon, G. H. Lowery, Jr., F. McKinney, M. T. Myres, K. C. Parkes, F. R. Scott, H. C. Seibert, R. W. Storer, J. T. Tanner, H. B. Tordoff, M. A. Traylor, J. D. Webster, A. Wetmore, R. Zusi.

NOTES AND NEWS

Request for Photographs of Birds

Those of our members who have first class bird photographs, which they would like to have published in THE AUK, are requested to send a list to the editor, giving the name of the species, the locality of the photograph, the sex depicted, whether the photograph also shows a nest with eggs or young, and whether the picture has been published elsewhere.

From time to time, a manuscript is accepted for publication that would be more attractive and meaningful if a first class picture of the species involved were included. If such opportunity arises, the editor will be able to communicate with those who indicate they have a suitable picture available. Ordinarily bird photographs will only be used when they either help to illustrate an article or note, or show some behavior interesting in itself.

THE AUK does not pay for photographs (any more than for manuscripts), but, of course, any such picture used will be credited to the photographer in the caption. It should also be borne in mind that, except in very special cases, THE AUK will not publish a photograph that has already appeared in some other ornithological book or journal. Of course publication in THE AUK will not preclude the photographer from publishing the picture thereafter elsewhere.

Chapman Memorial Fund

Awards for ornithological research are made in April of each year by the Frank M. Chapman Memorial Fund Committee of the American Museum of Natural History, New York. Applications should be received by March 15. Awards were made in 1958 for the following projects:

Edward Beals, University of Wisconsin: The ecology of the birds of the Apostle Islands.

Robert Ficken, Cornell University: The behavior of the Common Grackle, *Quiscalus quiscula*.

William George, University of Arizona: The significance of the hyoid bones in classifying birds.

Maria Koepcke, San Marcos University, Lima, Peru: A study of the Peruvian collections of birds at the American Museum of Natural History.

Nancy McAllister, University of Michigan: The reproductive ethology of the Pied-billed Grebe.

J. D. Macdonald, British Museum: A study of the bird collections at the American Museum of Natural History.

John Rogers, University of Missouri: The breeding biology and behavior of the Lesser Scaup.

Glen Sherwood, Utah State University: The relationship of the Whistling Swan to other waterfowl in the Great Salt Lake Valley of Utah.

Brenda Sladen, Johns Hopkins University: The respiratory system of birds.

National Science Foundation Grants

The Division of Biological and Medical Sciences of the National Science Foundation announces that the next closing date for receipt of basic research proposals in the Life Sciences is January 15, 1959. Proposals received prior to that date will be

reviewed at the Spring meetings of the Foundation's Advisory Panels and disposition will be made approximately four months following the closing date. Proposals received after the January 15, 1959, closing date will be reviewed following the Spring closing date of May 15, 1959.

Inquiries should be addressed to the National Science Foundation, Washington 25, D. C.

Letter to the Editor

Name-changing by the International Commission

The note by Mayr (1958, Auk, **75**: 225) in regard to the recent action of the International Commission on Zoological Nomenclature which calls for changing certain names rouses my grave concern. This is the Commission's *second* action involving the same names. The former was in 1955. Then, the Copenhagen Decisions on Zoological Nomenclature were unanimously adopted by the International Commission on Zoological Nomenclature! These "Copenhagen Decisions" contained (a) the article that dealt with changing the gender of certain generic names and made necessary further changes, (b) the recommendation that the International Commission consider this report binding until it got around to changing the articles, and that taxonomists guide themselves by these decisions until they were revised.

It has been pointed out to me that the changing of the gender of a generic name can be considered as not name-changing because it only necessitates a change in spelling of some specific and subspecific names. It has also been stressed that the Commission did not make the 1953 "Copenhagen Decisions," but only unanimously adopted them. Be that as it may, the A.O.U. Check-list Committee guided itself by the 1953 ruling while it was in effect! These changes by the Commission were based not on fact but on opinions of how to adapt dead languages to zoological nomenclature. What was right in 1953, was wrong in 1958 . . . and in 1968?

Another case in point is *Numida*, the generic name of the Guinea-fowls of Africa. *Numida* has been treated as feminine since the time of Linnaeus. However, in 1958, in Opinions and Declarations rendered by the International Commission on Zoological Nomenclature, Vol. 1, Sect. F., part F. 3, pp. 29–38, nearly 200 years of usage is upset by ruling that it is masculine. It was argued that only subspecies names are thus changed, but *N. mitrata* is commonly considered a species separate from *N. meleagris* and if this ruling be accepted it must be changed to *N. mitratus*. It seems that the tinkering being attempted in the name of stability may be worse than the disease.

In cases like these, making the species name agree in gender with the generic may be so complicated and unsatisfactory that papers are being written on this aspect of single genera. Scholars disagree. Usage is sometimes hopelessly confused. Fortunately, a simple remedy is at hand. It is to use the original spelling of the species and subspecies names. This proposal is not new. Hartert, perhaps the greatest modern avifaunalist, wrote, ". . . the way toward a stable nomenclature is that of preserving the original spelling entirely, and to regard all names merely as names, not as adjectives in connection with the genera as substantives. This will go far toward uniformity." (Ibis, 1904, p. 548). Vincent, in his "A Check List of the Birds of South Africa" (1952), has a similar view (see p. iv), and puts it into practice.

The only argument against it is that it would offend the cultivated ear. This might have carried more weight a generation or two ago, but today, with the decline of Greek and Latin teaching in our schools, it is an anachronism. The simplest way out of the morass is to settle on the original spelling.

In Mayr's note and the Editor's comment, there is the implication that the new A.O.U. "Check-list" should be "corrected" to conform to the recent, rather than the 1953 action. This I strongly urge not to be done! Individuals may act as they see fit. But we have a well done, usable list of North American birds. For biological reasons it may be necessary to alter names. But I am very much of the opinion that any nomenclatural tinkering with the names should be considered as the acts of individuals and not receive any appearance of legality or of sanction by the A.O.U.

We need a standard list of names, and spellings. We have it for North America in the 1957 A.O.U. Check-list. I urge that this volume be continued to be so considered until it is revised and reprinted. Only thus, by accepting a standard, can we hope for even a limited stability. A. L. RAND, *Chicago Natural History Museum, Chicago 5, Illinois.*

Ed. Note: In his comments on Dr. Mayr's earlier note on the gender of genera ending in *-rhynchus, -rhamphus* and *-gnathus*, the Editor merely called attention to the fact that A.O.U. Check-list genera were involved. Some will doubtless agree with Dr. Rand that, regardless of previous usage or classical purism, the interest of North American uniformity favors following the A.O.U. Check-list (1957) and treating the genera as neuter—at least until there is revision of the Check-list. Others, advocating international uniformity, will favor accepting the subsequently published decision of the International Commission (Ops. Decls. Internatl. Comm. Zool. Nomencl., 19, pt. 4, pp. i-xii, 1958), treating these genera as masculine, especially as this confirms almost universal usage in zoology (including American ornithology) from the time of Linnaeus, and was authorized by the terms of the admittedly tentative Copenhagen Decision on which the A.O.U. Committee had relied. As neither the decision of the International Commission nor the report of its classical adviser (Bull. Zool. Nomencl., 15, pt. 11, pp. 334–335, 1958) was available when the Check-list Committee acted, the question may be considered open from the viewpoint of the A.O.U. The Editor cannot fairly insist that authors follow the current Check-list on this point, when most of the genera involved are not limited to our area and there are numerous other extralimital genera having the same endings, which have invariably been treated as masculine. The choice of gender in this situation will be left to the individual author.

Dr. Rand's more drastic suggestion—that questions of gender be avoided by preserving the original endings of specific and subspecific names, regardless of the gender of the genus to which they may be transferred—would seem to require a change in our nomenclatural rules. Such change would make for simplicity in the future, but it would involve many alterations of current names to conform with the ending used by the original author.

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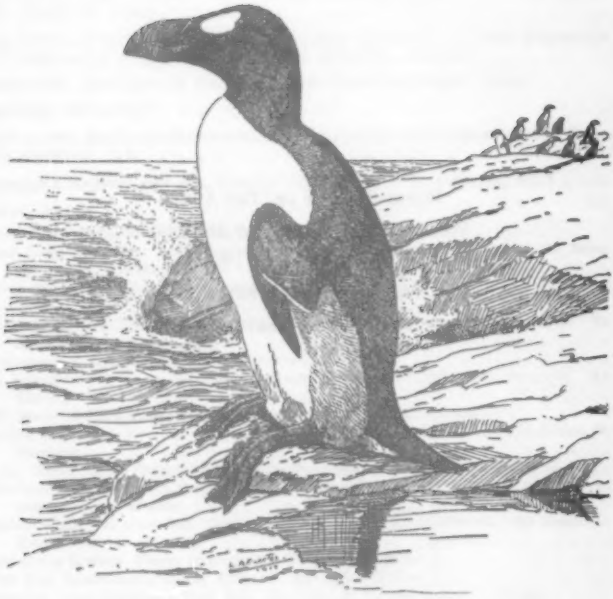

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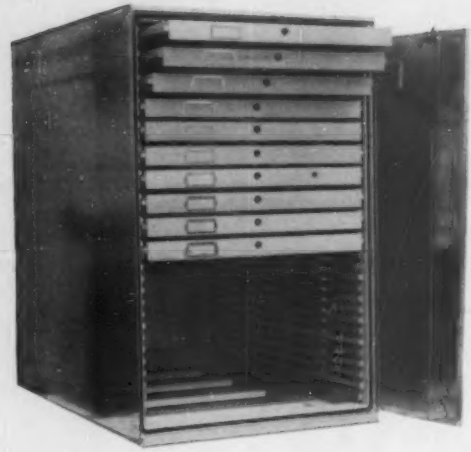

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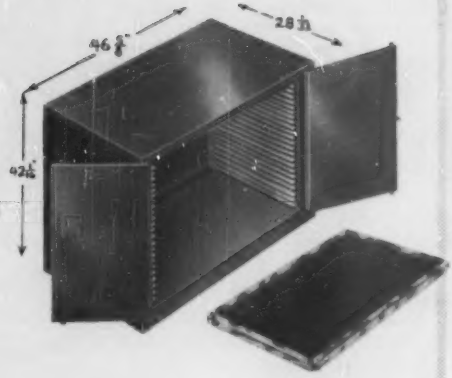

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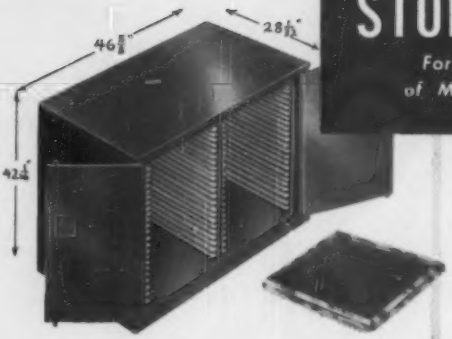

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